

A report commissioned by The Canberra Ornithologists Group Inc.

July 2001

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The Birds of Mulligans Flat Reserve

-A six year survey-

Summary
Between 1995 and 2000 fifty members of the Canberra Ornithologists Group conducted 26 surveys to determine the abundance and distribution of the bird species at Mulligans Flat Nature Reserve, ACT. Twenty four sites, representing five different habitats were surveyed for species richness and abundance. One hundred and four woodland species and 27 waterbird species were recorded.

Both the average number of species per site and their abundance decreased irrespective of season or habitat. The decline being particularly noticeable following the spring of 1998.

The reporting rate is compared with the results from a three year survey conducted in the area from 1986.

During the period of the 1995-2000 survey there was a decline in the abundance of seven species with a possible decline of another four species. In addition nine species that normally occur in small numbers were recorded less frequently. When compared with the 1986-1989 survey there was an increase in the reporting rate of eleven species and a decrease in 22 species. In addition there were twelve species recorded in 1986-1989, but not in 1995-2000 and twelve species recorded in 1995-2000, but not in 1986-1989.

Of the 22 species that have declined in abundance between the two surveys, 16 (73%) were species that obtained their food from or close to the ground compared to 39% of the total number of species recorded from Mulligans Flat.

The dry period between January 1997 and May 1998 did not appear to affect numbers, although during this period numbers increased at those sites that were centred around water.

Eighty-six percent of the declining species were resident species, therefore it is unlikely that the decline was caused by factors from outside the region.

Possible reasons are discussed for the changes and it appears most likely that much of the modification in the avifauna of the area has occurred either as a consequence of the dry period between January 1997 and May 1998, or due to changes brought about since the declaration of the area as a reserve in 1994.

Introduction

Beadle (1981) lists the dominant trees of temperate woodlands. Of the three principal woodland alliances only the Yellow Box *Eucalyptus melliodora* - Blakely's Red Gum *E. blakelyi* alliance is represented within the ACT. Within the ACT this alliance has been declared as an endangered ecological community (ACT Government 1999). Although these woodlands were once widespread throughout the flatter areas within the ACT, four principal factors have been identified that are responsible for the modification of the structure of these woodlands: ringbarking, selective clearing, the destruction of seedlings by rabbits and livestock and finally responses to disturbance where changes to floristic composition have occurred in response to clearing and grazing.

Threats to the remaining stands of the woodlands have been identified as clearing for agriculture and grazing, provision of urban services and infrastructure, firewood collection, failure of tree regeneration, rural die-back, pasture improvement, grazing by livestock and other animals, invasion by weeds and feral animals and finally inappropriate fire regimes (ACT Government 1999).

Frawley (1991) describes Mulligans Flat as the largest and most dense area of remnant open forest, woodland and grassland in the Gungahlin area. The reserve has been identified as an area containing significant stands of Yellow Box/Red Gum grassy woodlands with half of the area of very high conservation value and half of high conservation value (ACT Government 1999).

The assessment of the conservation status of the ACT flora and fauna and the identification of ecological significance and potentially threatening processes is the responsibility of the ACT Flora and Fauna Committee. Under criteria set out in its publication 'Threatened Species and Communities in the ACT, Criteria for Assessment' (1995) the Yellow Box/Red Gum grassy woodlands was declared an endangered ecological community in May 1997. In addition, six bird species associated with the Yellow Box/Red Gum grassy woodlands were declared as threatened. Five woodland bird species were declared as vulnerable and one woodland species was declared as endangered (Action Plan No. 15: Hooded Robin *Melanodryas cucullata*- vulnerable, Action Plan No. 16: Swift Parrot *Lathamus discolor*- vulnerable, Action Plan No. 17: Superb Parrot *Polytelis swainsonii*- vulnerable, Action Plan No. 18: Brown Treecreeper *Climacteris picumnus*- vulnerable, Action Plan No. 19: Painted Honeyeater *Grantiella picta*- vulnerable, Action Plan No. 20: Regent Honeyeater *Xanthomyza phrygia*- endangered).

The plans require management actions that include the surveying and monitoring of the woodlands and their associated fauna and of the various threatened bird species that are dependent on those woodlands. In order to provide this information and to enhance the monitoring activities of Environment ACT (Wildlife Research and Monitoring) Canberra Ornithologists Group (COG) extended the bird survey that had been conducted at Mulligans Flat since mid 1995 to include 82 additional sites with an additional 9 yet to be incorporated.

The aim of this report is to 1) describe the distribution and abundance of the avifauna within Mulligans Flat Nature Reserve 2) to assess any changes since 1986 and 3) discuss possible changes since the declaration of the Reserve in 1994. Particular reference will be made to the occurrence and abundance of the six threatened species within the ACT and to the twenty species identified as being of concern in the New South Wales sheep-wheat belt (Reid 1999).

Background

Mulligans Flat has long been recognised by ornithologists as an area of significant value to birds. Starting in September 1986 a large part of the present reserve was surveyed for three years as part of the COG's ACT Bird Atlas survey, a project conducted under contract to the National Capital Planning Authority and its predecessor the National Capital Development Commission (Taylor and Canberra Ornithologists Group 1992).

At this time additional interest was shown in the area as efforts were made to ensure the area's preservation. This resulted in various publications describing the ecological significance of the area (Osborne *et al.* 1992), the mammal fauna of the area (Smille 1999) and the vegetation (Lepschi 1993). In addition, a biodiversity survey of the area was conducted by students from the Australian National University, Dept. of Forestry between 27 September and 1 October 1999 (Fischer 1999).

Ornithological data collected during the ACT Bird Atlas and additional data from *ad hoc* outings to the area by COG members were incorporated in a submission to the ACT Chief Minister on a proposal to declare Mulligans Flat a reserve incorporated into the Canberra Nature Park (Lindenmayer 1992). As a result of this submission, and in recognition of the area's importance to the flora and fauna of the region, Mulligans Flat was declared as a nature reserve and incorporated into the Canberra Nature Park in 1994.

Stock and internal fences were removed by late 1994. An additional area of 28 ha adjacent to the south-west boundary is in the process of being added to the reserve. By 1995 COG had been involved in surveys and *ad hoc* visits within part of the reserve for nine years. In order to maximise the value of these data COG decided to initiate a survey that would assess the distribution and abundance of bird species within the nature reserve. The aim of the survey was to obtain data that could be used to assess changes in the avifauna of the reserve caused by a change in land management and the encroaching suburban development.

The survey commenced in June 1995 and continues to date. At the start of the survey the nearest suburban development was 3 km away from the southern boundary of the reserve. At the time of writing the nearest development is less than 1 km away and by 2005 it is expected that suburbs will abut the southern boundary.

Methods

Survey site

Mulligans Flat Nature Reserve (35^0 11'S, 149^0 08'E) covers an area of 765 ha, situated on both sides of Gundaroo Road. The reserve abuts the northern boundary of the ACT. At present it is bordered to the south by grassland, which in approximately four years will disappear under suburbia.

The topography of the reserve consists of a range of undulating hills running north-west to south-east which defines the northern boundary and the ACT border. The larger area to the east of Gundaroo Road consist of two moderately sloping ridges running north-east to south-west and are separated by a relatively flat valley (Frawley 1991). Both ridges taper to the south-west and merge with the more fertile flatter valley. The smaller area to the west of Gundaroo Road consists of undulating hills leading to grassland flats to the south-west.

The geology consists predominantly of siltstone and mudstone with a small area of dacite. Some quartz outcropping is present specially along the southern ridge. Shallow lithosols are formed on the ridges and slopes with soled soils on the flatter areas (National Capital Development Commission 1988).

The area is drained by ephemeral creeks and their tributaries which run approximately parallel to the ridges. The area supports a number of small stock dams . A large dam situated in the southern end of the reserve usually contained water throughout the year although during the winter of 1998 the wall was breached and the dam did not refill until repaired in early 1999.

The vegetation of the area is described by Lepschi (1993) from data collected between 1988 and 1989 with some records from 1991 and 1992, thus the description is based on information prior to the changes in the grazing regime brought about by the change in management in March 1994. In addition the survey did not cover the entire area of the present reserve but covered an area of 275 ha situated in the north-west section east of Gundaroo Road.

Three broad vegetation types occur at Mulligans Flat; open forest, woodland and grassland. The open forest occurs predominantly on the shallow soils of the ridges and slopes. Dominant species are *E. macrorhyncha*, *E. rossi* and *E. mannifera* with some *E. goniocalyx*. There is much eucalypt regeneration and small trees such as *Acacia dealbata*, *A. parramattensis* and *Exocarpus cupressiformis* and various shrub species. The ground layer where present consists of various grasses and herb species. On the flatter sites with deeper soils the woodlands are dominated by the endangered Yellow Box (*E. melliodora*)/Red Gum (*E. blakelyi*) grassy woodland community with scattered *E. bridgesiana* and *E. rubida*. The understorey is generally sparse with eucalypt saplings and scattered stands of mainly *A. dealbata* and various shrubs. Grasses and herbs make up the ground cover. In the grasslands *Panicum effusum* var. *effusum* and *Themeda australis* are common components where light grazing has occurred. In areas of heavier grazing *Aira* spp., *Bothriochloa macra* and *Chloris truncata* are common. For a more detailed description of the various vegetation types

see Lepschi (1993) who noted that the description was not exhaustive and that many more species could be expected once stock had been removed from the area.

The vegetation of the area is also described by Osborne *et al.* 1992 and in the submission to the ACT Chief Minister (Lindenmayer 1992). Both these publications describe the vegetation whilst the area was under private lease for grazing. The former publication being particularly informative as it describes the various grazing pressures within areas of the reserve.

In the Osborne *et al.* 1992 report Mulligans Flat is described as the area that separates the two ridges that run north-east to south-west- see Figure 1. The northern Flat is described as being intensively grazed with patches of epacrid heath and extensive groves of *A. dealbata*. This area is represented by survey sites 4 and 18. The central flat contains many specimens of large *E. melliodora* and *E. blakelyi* with a number of small dams. This area is represented by sites 1, 2, 3 and 11. Within the southern flat grazing pressure was less resulting in extensive themeda grasslands and scattered eucalypts. This area is not within the present reserve boundary. There are three ridge areas described. The west ridge was the most disturbed, dominated by *E. macrorhyncha* and *E. goniocalyx*. The area was littered with extensive sheep camps and the understorey was much disturbed and overgrazed. This area is represented by sites 6, 7, 8 and 9. The northern ridge was again extensively denuded by sheep activity and this is represented by site 10. The lower slopes supported patches of woodland and thickets of *A. dealbata* which merge into the area represented by sites 4 and 18. The east (quartz) ridge is represented by sites 5, 12, 19, 20 and 23 experienced limited grazing pressure due to unpalatable grasses, poor soils and dense cover dominated by *E. macrorhyncha* and *E. mannifera* although the two latter sites are situated in acacia thickets. The south-east flat was cleared farmland and characterised by a progression from dense tussock grass understorey beneath forest eucalypts to open grassland including themada swards beneath regenerating *E. blakelyi*. To the north, represented by sites 21 and 22 *A. dealbata* regrowth occurs as dense groves. To the south the area is dominated by a large dam and includes areas of *E. melliodora* and *E. blakelyi* with grassy understorey and represented by sites 13, 14, 15,16, 17 and 24. To date there has been no detailed survey of the vegetation since the declaration of the area as a nature reserve.

Survey methods

1986-1989

During the survey period of the ACT Bird Atlas project that ran from September 1986 to August 1989 birds were surveyed within a series of 2.5 minute cells each measuring approximately 3.5 km by 4.5 km (Taylor and Canberra Ornithologists Group 1992). Each cell was identified by a unique number. The present reserve is covered by four cells; L10, L11, M10 and M11 although during the atlas survey period virtually all surveys were conducted within cell L10. Because specific locations within the cell could be identified it has been possible to isolate those surveys from within the Mulligans Flat from other surveys within cell L10. The two observers (J. Bounds and B. Lepschi) responsible for virtually all of the observations spent approximately three to four hours during the early hours of the morning recording the presence of all species seen and heard (J. Bounds *pers. comm.*). For most of the surveys within L10 the two observers remained together as they covered the area. On only a few

occasions was only one observer present. During the period, the area was surveyed on 25 occasions. This area covered 13 of the 24 sites (Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 18, 19, 20, 23) subsequently surveyed during the present study.

1989-1995
Between August 1989 and May 1995 Mulligans Flat continued to be visited by COG members either as individuals or as group outings. Observations were submitted and entered into the COG database on eight occasions in 1991, six in 1992 four in 1993, 16 in 1994 and on 20 occasions to end of May 1995. Over this period the number of species recorded varied between one and 66. These data have not been analysed because the duration of visits varied considerably as did the number of observers and the area covered.

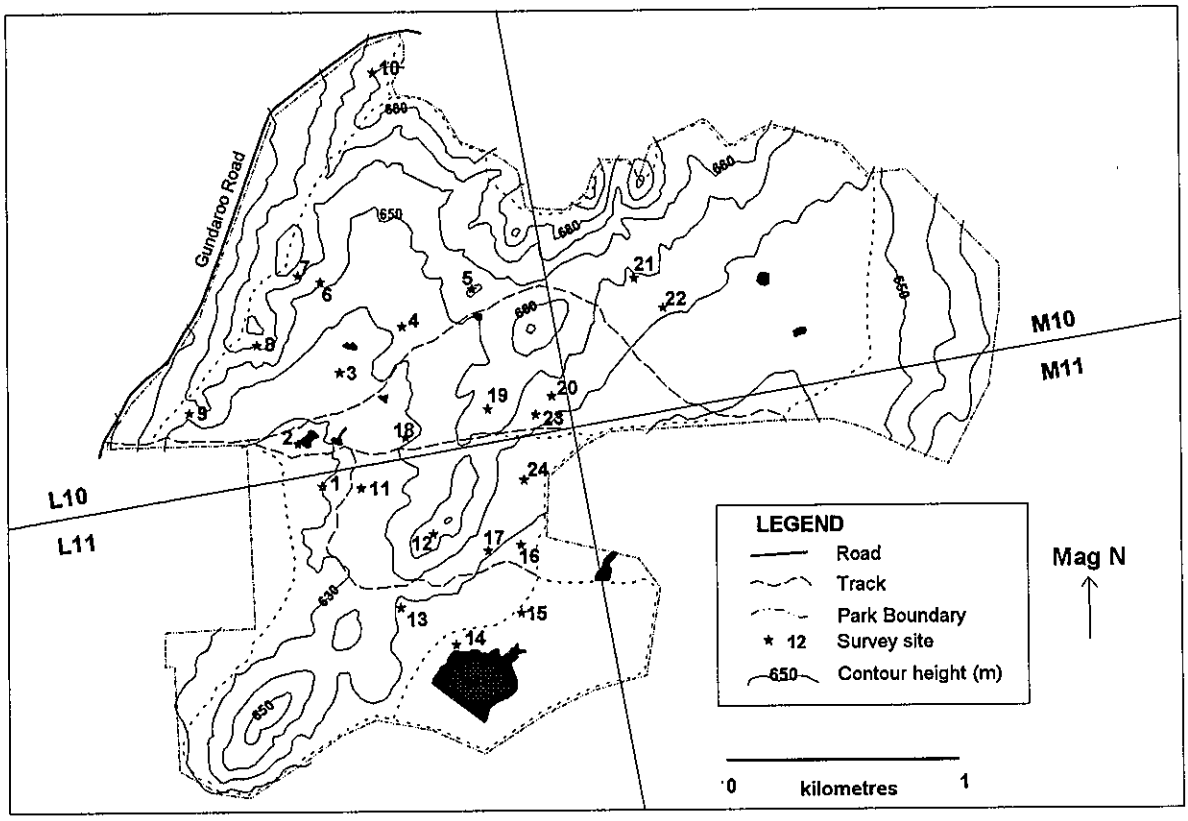
1995-2000
At the end of 1994, after a successful application for an ACT Heritage Grant and an ACT Environment Grant a protocol was established to survey the area at least once for each season of the year for a five-year period. The spring season would be surveyed twice to gather as much data on breeding as possible.

Based on topography and vegetation, five habitats were identified. The east (quartz) ridge was identified as a major topographical feature dividing the area into two nearly equal areas. After mapping the habitats, survey sites were allocated at random taking into account the relative area of the different habitats. Twenty-four sites were chosen, 12 on each side of the quartz ridge: ridge woodland which included the *E. macrorhyncha* and *E. mannifera* habitat (6), open woodlands including the *E. melliodora*, *E. blakelyi*, *E. bridgesiana* and *E. rubida* habitat (6), grasslands (4), mixed grassland/shrub which included the low heath and *A. dealbata* thickets (4) and finally four sites centred on dams. After assessing the random points on the ground and taking into consideration access and time constraints the 24 sites were allocated as follows: ridge woodland (5, 7, 8, 10, 12, 19), open woodland (1, 3, 6, 11, 13, 15, 17), grassland (9, 16, 24), mixed grassland/shrub (4, 18, 20, 21, 22, 23) and dams (2, 14) (see Figure 1 and Appendix I for geographical locations).

In late May 1995 each of the 24 sites were marked with a permanent marker. Five to six teams of between one and three people surveyed the sites starting within an hour of sunrise for about three hours (see Appendix II for contributors). The sample plot method (Edwards *et al.* 1981), otherwise known as the point count method (Recher 1988), was used in preference to the variable circular plot to reduce the problem of estimating distances by many different observers. Although observers generally remained stationary at the central marker they could move within the plot to confirm sightings and to estimate species abundance. Each site was surveyed for 15 minutes with the number of individuals of each species seen or heard within a 50 m radius (0.8 ha) of the marker recorded. Species seen or heard outside the circle were recorded separately as was any individual flying overhead or through the plot. Observers were requested to record only those species in areas of similar habitat to that found inside the circle. Only 48 of the 9981 records (0.5%) were of birds flying overhead or through the plot and for this analysis are regarded as having been recorded from within the plot. Each site was surveyed once during each visit. If more than one person

surveyed the site only one was the observer. There was no attempt to randomise observers between sites with individuals often surveying their 'favoured' site

Figure 1. Map of Mulligans Flat Nature Reserve, ACT.



All effort was made to ensure that individuals were not counted more than once. Because of the relative open nature of the habitat and the small radius of the plot all species in all habitats had an equal probability of being recorded. For the two dam sites (2 and 14) the centre of the plot was taken to be in the centre of each dam.

Because of the way in which observations were recorded at each site, data on both the number of species and the abundance of each species using an area of 0.8 ha over a 15 minute period were collected. These data provide information on the species richness and relative abundance within a specific habitat type. In addition data on species richness and abundance for each site were collected from an undetermined area outside the 50m radius plot. Due to the increased difficulty of assessing the number of individuals outside the circle and because the larger area may include different habitat types, the abundance data collected from outside the plot has not been analysed in this report. Species richness data though has been used to provide information on the general area surrounding the site rather than on any specific habitat. Because data on habitats provide information on species richness and abundance, indices of species diversity can be assessed for each of the survey sites.

In September 1998 the woodland survey at Mulligans Flat was expanded to include additional sites in the ACT within the endangered *E. melliodora/ E. blakelyi* grassy

woodland community. The expanded survey included a slight change to the survey protocol such that each additional survey area contained nine sites with each site to be covered by two observers only. In mid-1999 before the start of the new survey, a representative number of sites were surveyed at Mulligans Flat and the number of individuals recorded before and after 10 minutes was noted. The number of new individuals recorded after 10 minutes was negligible so it was decided to reduce the survey period for each site from 15 minutes to 10 minutes thus allowing a greater number of sites to be surveyed. At Mulligans Flat from mid-1999 a line was drawn on the data sheet that allowed those species recorded after 10 minutes to be identified, but this ceased after July 2000 so the final survey (17/9/2000) was surveyed for a 10 minute rather than a 15 minute period.

In August 1995 a photo of each survey site was taken to depict the vegetation, sites 6 and 9 were photographed in November 1995. The process was repeated 5 years later when a series of three photos taken from the centre of each site facing 0^0, 120^0 and 240^0 was taken on 2 July 2000 a.m. for sites 16-19, 24; 9 July 2000 p.m. for sites 1-5, 11-15, 20-23 and 22 July 2000 p.m. for the remaining five sites. For the two dam sites, the photos were taken from the dam wall for site 2 and at a point about 50 m north-west of the dam for site 14. The photos are kept by J. Bounds (Figure 2a-2e).

No assessment of the structure of the vegetation had been made when the sites were set out in May 1995, with sites being allocated to various habitat types by a quick visual assessment only. On 24 December 2000 each site was assessed for vegetation structure and complexity using a version of the Catling and Burt (1995) score modified by A. Rowell for use by the COG woodland survey. The assessment has been modified to specifically relate to birds in eucalypt woodlands and is still in draft form. The assessment considers the percentage cover of the tree canopy, shrub layer(s), herb layer, rocks and logs, the tree health, number of tree species, amount of regeneration, number of tree hollows and the amount of mistletoe present and is taken as an assessment of the 0.8 ha survey plot only- see Appendix III for data sheet format.

The original survey protocol required observers to not only record species at each survey site, but also to regard the route between survey sites as a transect and record the species along the transect thus improving the chances of recording the presence of the rarer species. Records were taken during half of the surveys but were then stopped. Although the data have been entered into the COG database they are not analysed here.

The names of bird species are taken from Christidis and Boles 1994. For scientific names see Appendix IV which lists the woodland and waterbird species recorded at Mulligans Flat during either the 1986-1989 or the 1995-2000 surveys. Records of the Grey Falcon, Olive Whistler, Crimson Chat and Pied Cormorant have not been included in the analysis as they have been regarded as errors in identification.

Statistical procedures

The data consists of a repeated measures set of data on a number of sites. The analysis involves a split plot in time model using GENSTAT (GENSTAT5 Committee 1995) where the fixed effects are the vegetation type and season and the random effects are the plots, the years within plots and the seasons within years within plots. Using the



Figure 2a. Site 14 (Dam site)



Figure 2b. Site 17 (Open woodland site)

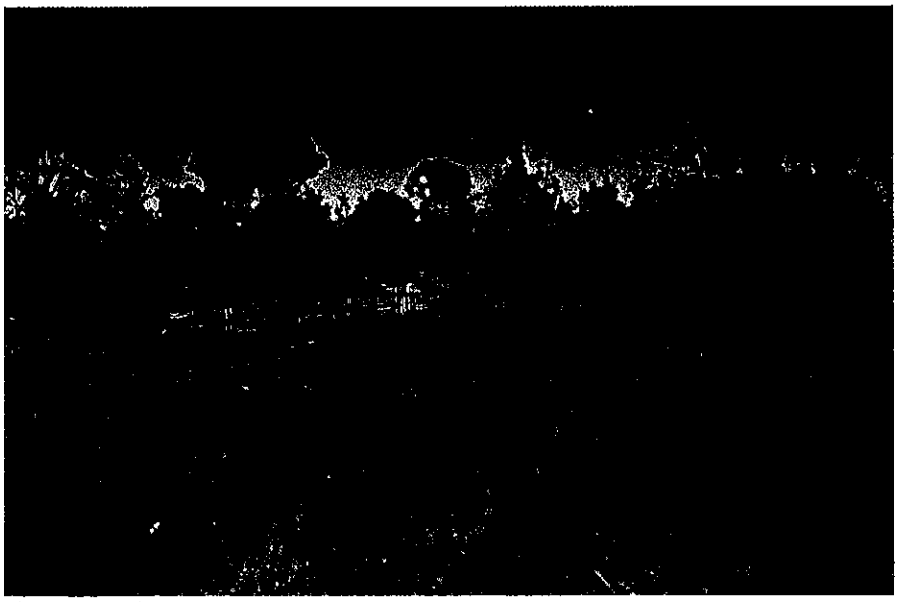


Figure 2c. Site 22 (Mixed grassland/shrub)



Figure 2d. Site 8 (Ridge woodland)

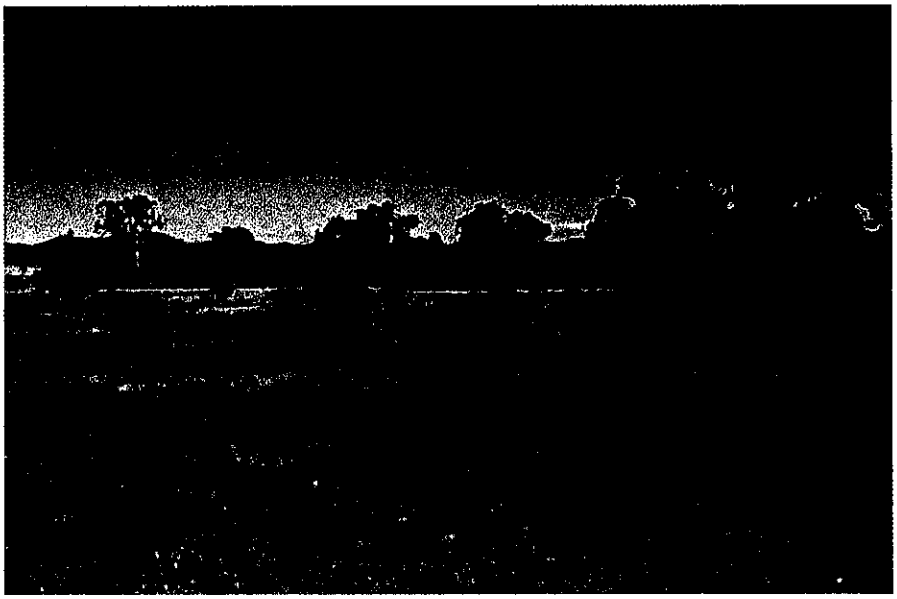


Figure 2e. Site 24 (Grassland)

Wald statistic it is possible to test for the fixed effects of vegetation type and season with their interaction. All data were transformed by log+1 to avoid problems associated with zeros in the data set. In addition means have been compared using a Kruskal-Wallis analysis of variance test and a test of mean ranks using Dunn's multiple comparison technique.

Results

Survey effort

Between June 1995 and September 2000 bird surveys at Mulligans Flat Nature Reserve were conducted by members of COG on 26 occasions. Over this period, 50 observers were involved (Appendix II) with an average of 13 observers per survey. Each survey covering all 24 sites took approximately 3 hours and 30 minutes to complete. If an average travel time of 45 minutes to and from the area is included, the total volunteer effort over the six-year period is 1437 volunteer-hours. All sites were visited on 26 occasions. On each occasion birds were recorded except on a single occasion for six sites (2, 8, 14, 18, 21 and 24) when no species were observed. Over the six-year period there were six surveys during the winter months, ten during the spring, five during the summer and five during the autumn months with three surveys in 2000, four in 1995, and 1999 and five each in 1996, 1997 and 1998. Although sites were not visited in any random order, observer groups would visit sets of plots in different orders so that in effect plots for each habitat type were visited in random order.

Survey site description

The location of the 24 sites was chosen to represent the variation found within the five habitats that had been mapped based on previous knowledge of the topography and vegetation of the area. The habitat assessment score was designed so that higher scores reflected higher structural complexity. Two of the three grassland sites recorded the lowest score whilst two of the open woodland sites recorded the highest score (Table 1).

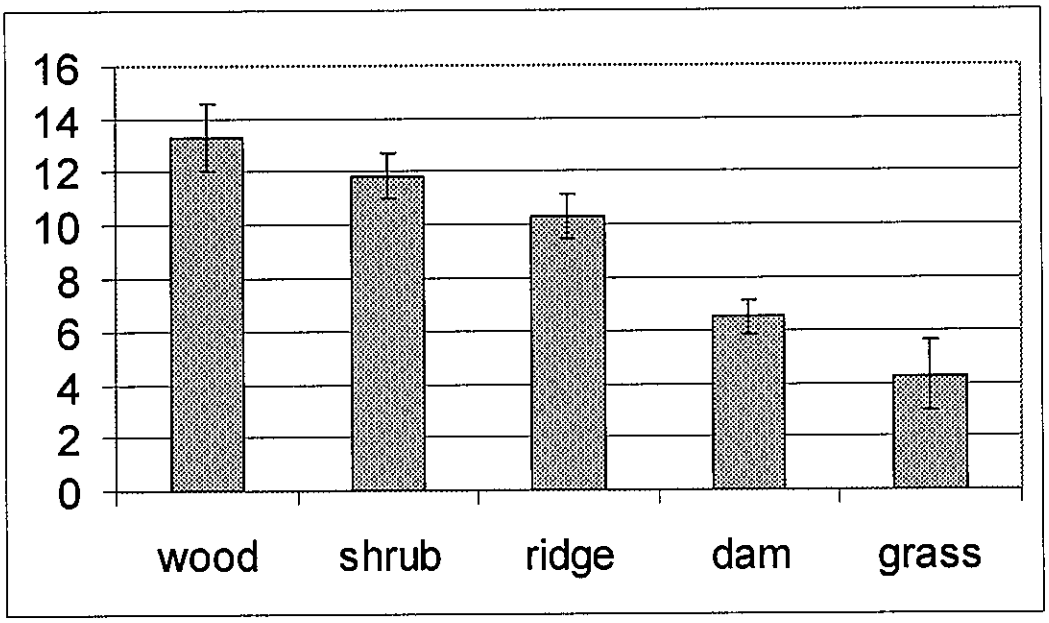
Although the habitat with the highest average structural score was the open woodland there was no statistical difference between the scores of the open woodland, the ridge woodland, the mixed grassland/shrub or the dam but, not surprisingly, the grassland habitat was different from the other four habitats (ANOVA d.f. 4, $p<0.001$) (Figure 3). By removing the grassland sites from the analysis the open woodland sites are then significantly different to the two dam sites but not to the mixed grassland/shrub sites or to the ridge woodland sites (ANOVA d.f. 3, $p=0.02$).

There was a similarity in tree canopy, eucalypt regeneration and number of tree species scores between the open woodland, ridge woodland and the mixed grassland/shrub. The ridge woodland and grassland habitats lacked the tall shrubs and ground layer whilst short shrubs were virtually restricted to the mixed grassland/shrub habitat. Logs and fallen timber were to be found in all habitats except the grassland with the ridge woodland habitat having on average the highest score for this attribute. Tree hollows were virtually restricted to the open woodland sites whilst mistletoe was only recorded from two sites. Tree health was similar within all habitats.

Table 1. Habitat assessment scores for 24 sites at Mulligans Flat Nature Reserve, ACT.

Sites	Grass			Mean	Ridge						Mean	Woodland							Mean	Shrub						Mean	Dam		Mean
	9	16	24	score	5	7	8	10	12	19	score	1	3	6	11	13	15	17	score	4	18	20	21	22	23	score	2	14	score
Attributes																													
Tree canopy	0	0	0	**0.0**	2	2	2	1	2	2	**1.8**	2	1	2	2	2	1	2	**1.7**	1	1	1	1	1	2	**1.2**	0	0	**0.0**
Euc regeneration	0	0	1	**0.3**	2	2	2	1	0	0	**1.2**	0	1	1	2	2	2	1	**1.3**	0	1	1	1	0	1	**0.7**	0	0	**0.0**
Number tree spp.	0	0	1	**0.3**	1	1	1	1	1	2	**1.2**	1	1	2	2	1	1	2	**1.4**	0	1	1	1	1	2	**1.0**	1	1	**1.0**
Tree health	2	2	1	**1.7**	1	2	2	2	2	2	**1.8**	2	2	2	2	2	1	2	**1.9**	2	1	1	2	2	2	**1.7**	2	1	**1.5**
Tall shrubs	0	0	0	**0.0**	0	1	0	1	0	1	**0.5**	1	1	1	2	1	0	1	**1.0**	2	1	2	1	1	1	**1.3**	0	0	**0.0**
Short shrubs	0	0	0	**0.0**	0	0	0	0	0	1	**0.2**	0	0	0	1	1	0	1	**0.4**	2	2	1	1	1	1	**1.3**	0	0	**0.0**
Native shrubs															1	1		1	**1.0**	1	1					**1.0**			
Ground layer	0	1	1	**0.7**	2	0	0	0	0	2	**0.7**	2	1	1	2	1	1	2	**1.4**	1	2	2	1	1	2	**1.5**	1	0	**0.5**
Native ground layer	1	0	2	**1.0**	2	1	1	1	0	2	**1.2**	2	2	2	2	2	1	2	**1.9**	1	2	2	1	1	2	**1.5**	2	1	**1.5**
Logs	0	0	0	**0.0**	1	1	1	2	1	1	**1.2**	0	0	1	1	1	1	1	**0.7**	1	1	0	1	1	0	**0.7**	1	1	**1.0**
Rocks	0	0	0	**0.0**	0	0	0	0	1	0	**0.2**	0	0	0	0	0	0	0	**0.0**	0	0	0	0	0	1	**0.2**	0	0	**0.0**
Tree hollows	0	0	1	**0.3**	1	1	0	0	1	0	**0.5**	1	2	1	1	1	0	1	**1.0**	0	1	0	0	0	0	**0.2**	0	2	**1.0**
Mistletoe	0	0	0	**0.0**	0	0	0	0	0	0	**0.0**	0	1	0	0	0	0	0	**0.1**	0	0	2	0	0	0	**0.3**	0	0	**0.0**
Total score	3	3	7	**4.3**	12	11	9	9	8	13	**10.3**	11	12	13	18	15	8	16	**13.3**	11	14	13	10	9	14	**11.8**	7	6	**6.5**

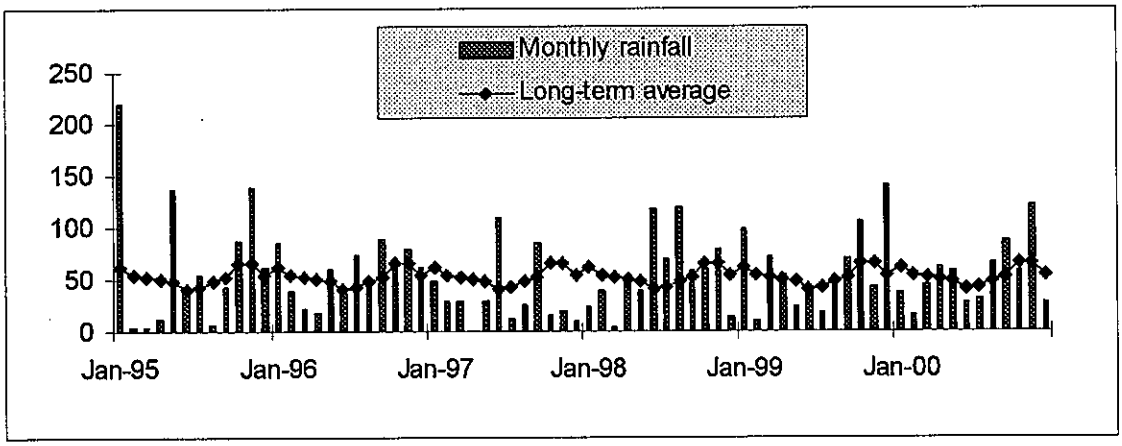
Figure 3. Mean habitat assessment score (+/- s.e.) for five habitat types at Mulligans Flat Nature Reserve, ACT.



.Weather

Monthly rainfall records were obtained from the Bureau of Meteorology. The records were taken from Canberra Airport. The long-term average monthly figures were obtained from records taken from 1939 to the present. The January and November 1995 monthly rainfall totals were the highest recorded, with the May 95 rainfall close to the highest, since records began in 1939 (Figure 4). 1995 was therefore a very wet year with a total of 801mm. From January 1996 through to December 2000 the annual rainfall was similar at around 650mm except for 1997-1998 when the total dropped to around 400mm. The period of low rainfall lasted from January 1997 to May 1998; a period in which every month except two were below the long-term average.

Figure 4. Monthly rainfall, 1995-2000 and long-term average from 1939 to 2001.



WOODLAND BIRDS

The split plot in time model tests for the fixed effects of habitat type and season and of the interaction between the two. The interaction between season and habitat for species richness was not significant (Wald statistic 18.02, d.f.12, p=0.115) neither was the interaction between season and habitat for species abundance (Wald statistic 15.03, d.f.12, p=0.24), thus for both species richness and species abundance the effects of season did not change with habitat so only differences in numbers between season and habitat need to be considered.

Species richness

Over the six years of the woodland survey, 104 species of woodland birds and 27 species of waterbirds were recorded from the survey plots (Table 2).

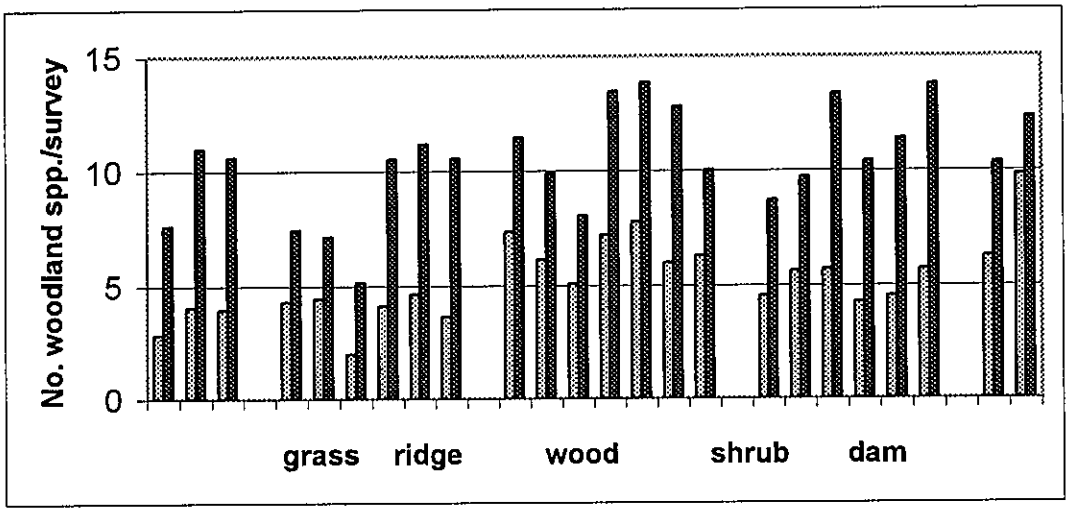
Table 2. Total number of species recorded from five different habitat types at Mulligans Flat Nature Reserve, ACT.

	Grass	Ridge	Wood	Shrub	Dam	Total
No. woodland species	47	56	70	56	60	104
No. waterbird species	1	2	2	3	21	27
No. sites	3	6	7	6	2	24

The largest number of woodland species was recorded from within the open woodland habitat with seventy species having been seen over the survey period. The lowest number was recorded from the grassland sites with the remaining three habitats having a very similar number of species. There was a surprisingly large number recorded from the two dam sites, in particular site 14. As to be expected the two dam sites also recorded the largest number of waterbird species.

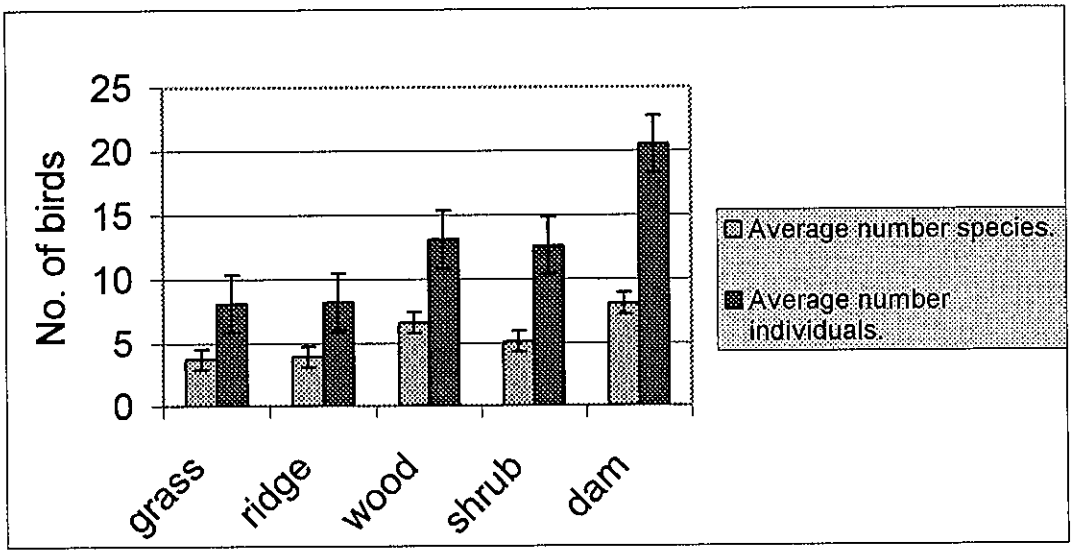
Not surprisingly, at each site the average number of species recorded per survey from within the plot was less than the number recorded from the site as a whole, with on average more than double the number recorded (Figure 5). There was a poor relationship between the total number of species recorded at a site and the number recorded from within the plot with a low correlation coefficient (r^2= 0.396). The most likely reason for this is that the additional species recorded from outside the plot were not necessarily from the same habitat as those from within the plot.

Figure 5. The average number of woodland species from within plots (open) and from inside and outside plots (stippled) for 24 sites at Mulligans Flat Nature Reserve, ACT.



The average number of woodland species observed per survey varied considerably between sites (Figure 5), with the greatest number recorded from within the dam site 14 and the lowest from within ridge woodland site 8. When combining the various sites into their respective habitats there was a significant difference between habitats (Wald statistic 28.03, d.f. 4, $p<0.001$). Dunn's multiple comparison of mean ranks indicated that the mean number of species was significantly different between all habitats except between the grassland and the ridge woodland habitats and between the dam and the open woodland habitat. The dam and the open woodland sites recording the greatest number of species on average, whilst the grassland and ridge woodland recorded the lowest (Figure 6).

Figure 6. The average number of woodland species (+/- s.e.) and average number of individuals within plots per survey for five habitat types at Mulligans Flat Nature Reserve, ACT.



Relative abundance

The number of individual woodland birds recorded also varied considerably between sites with ridge woodland site 8 recording on average 4.2 individuals/ survey and dam site 14 recording 26.5 individuals/ survey. The maximum number seen at any one visit was of 81 at mixed grassland/shrub site 22. This observation consisted of 10 species of which there were 20 Buff-rumped Thornbills, 20 Silvereyes and 12 Superb Fairy-wrens.

When combining the sites into their respective habitats (Figure 6) there was a significant difference in the number of individuals between habitats (Wald statistic 25.68, d.f. 4, $p<0.001$). Dunn's multiple comparison of mean ranks indicated that the average abundance was significantly different between all habitats except between the grassland and the ridge woodland habitats and between the mixed grassland/shrub and the open woodland habitat. The dam sites had on average the highest relative abundance with the grass and ridge sites having the lowest.

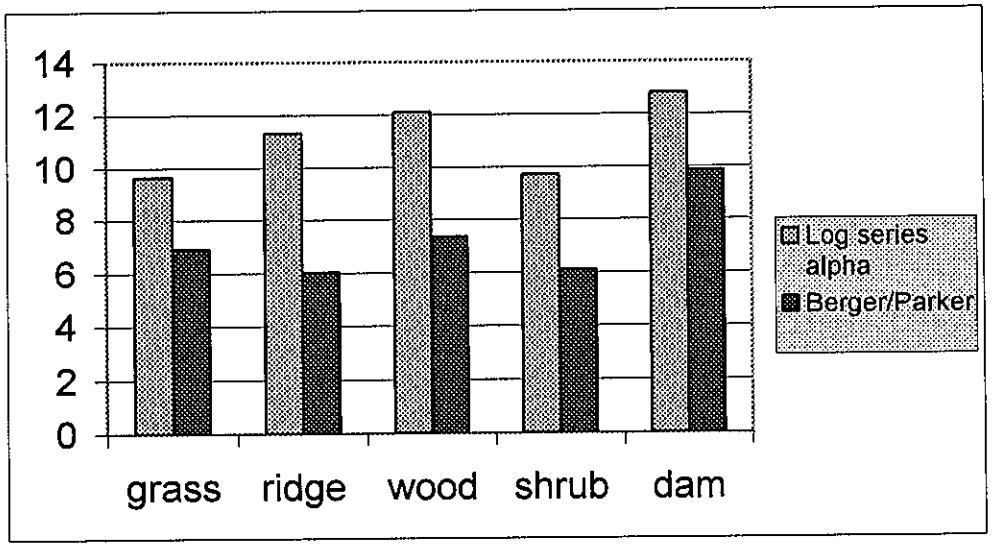
In summary the grassland and the ridge woodland habitats contained a small but similar number of species with a similar number of individuals, whilst for a similar number of species the dam habitat contained many more individuals than the open woodland.

Species diversity

Indices of species diversity involve the relationship between species richness and abundance. There are many different indices each accentuating the relationship in different ways, see Magurran (1988) for a review of the topic. Log series alpha index of diversity is simple to calculate, widely used and, with a low sensitivity to sample size is used here in preference to the more commonly used Shannon index which is more sensitive to sample size. Indices of diversity may be influenced by one or a few species being particularly abundant. The Berger/Parker index is used as a measure of dominance; the lower the value the greater the dominance.

For woodland birds, dam site 2 was the most diverse followed by five open woodland sites and two ridge woodland sites. The least diverse sites were the grassland sites and four of the mixed grassland/shrub sites. When combining the sites into their respective habitats the dam sites were the most diverse followed by the open woodland sites (Figure 7). The least diverse were the mixed grassland/shrub and the grassland habitats. The mixed grassland/shrub and the ridge woodland were the two habitats that were most influenced by species dominance. The site most affected was mixed grassland/scrub site 20 with Buff-rumped Thornbills followed by open woodland site 15 with Noisy Miners and grassland site 9 with Common Starlings. It is of interest that dam site 14 contained the large dam and most of the Noisy Miners suggesting that the large dam is affecting the dominance index of nearby site 15.

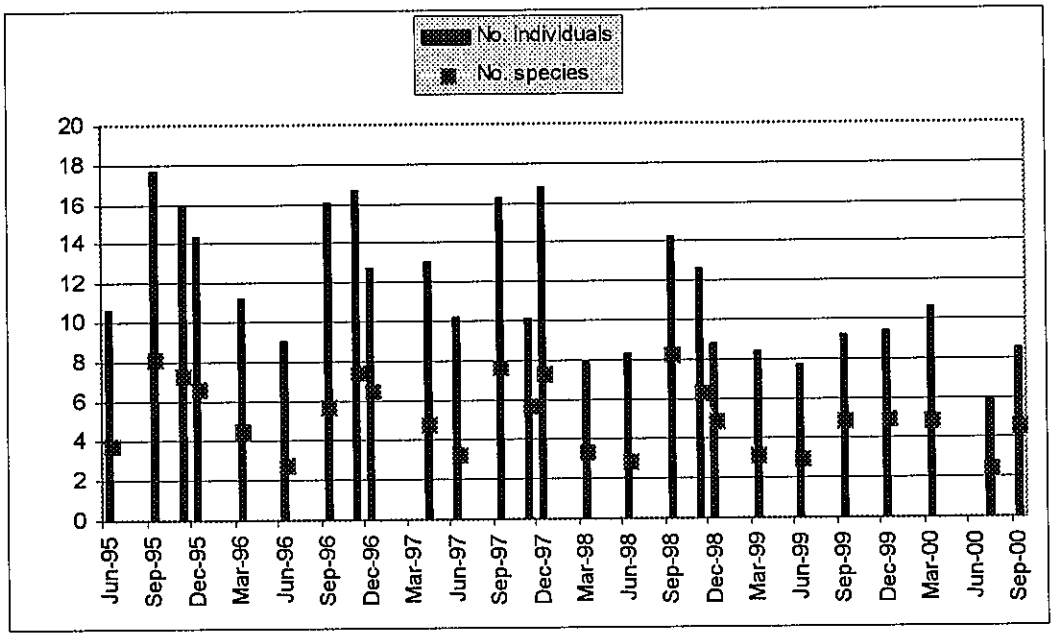
Figure 7. Species diversity indices for five habitat types at Mulligans Flat Nature Reserve, ACT.



Changes in species richness and abundance between 1995 and 2000.

Between June 1995 and September 2000 the number of species and their abundance fluctuated with the seasons, being lowest during the winter months and highest during the spring and summer (Figure 8) reflecting the changes in the ACT avifauna caused by the arrival and departure of winter and summer migrants, but despite these fluctuations there appears to be a general decline in both species richness and abundance over the course of the survey.

Figure 8. The average number of species and their abundance per survey from 24 sites between June 1995 and September 2000, Mulligans Flat Nature Reserve, ACT.



The average number of species observed over the survey period decreased from 6.2 per site in 1995 to 4.1 in 2000 (Figure 9) whilst the average number of birds decreased from 14.4 in 1995 to 8.5 in 2000 (Figure 10). On closer examination both the number of species and their abundance decreased during the winter, spring and summer seasons over time but not during the autumn season.

Figure 9. The average (+/-) s.e.) number of species per site, per annum and per season, 1995-2000, Mulligans Flat Nature Reserve, ACT.

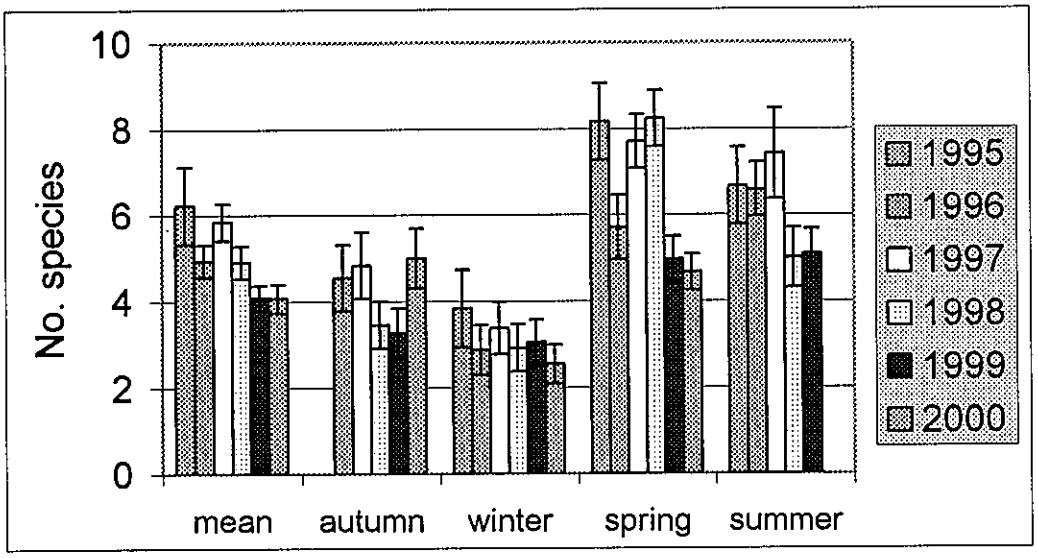
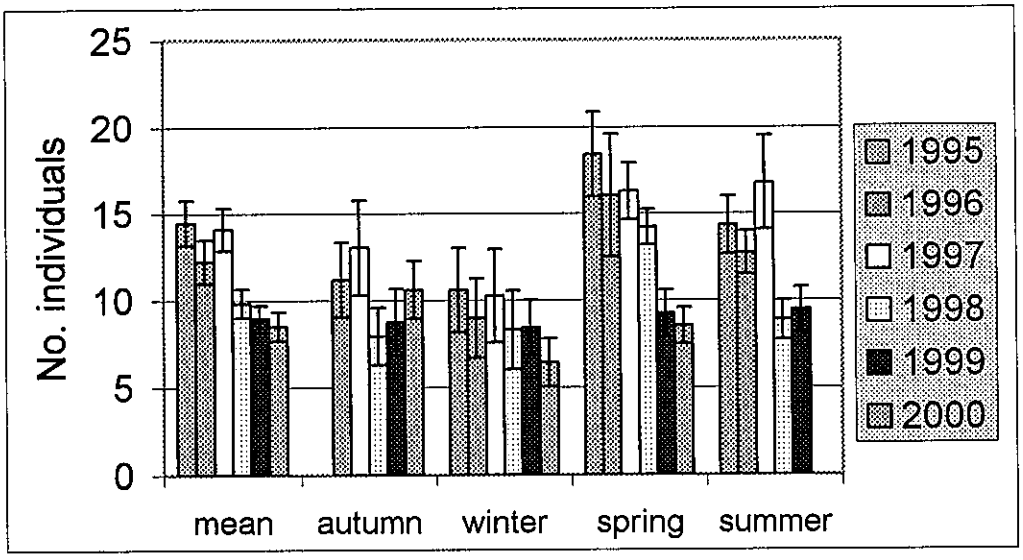


Figure 10. The average (+/-) s.e.) relative abundance per site, per annum and per season, 1995-2000, Mulligans Flat Nature Reserve, ACT.



There was a significant difference in the average number of species for the mean values (Kruskal Wallis ANOVA, $H=16.91$, d.f. 5, $p<0.001$) (Figure 9). The Dunn's method of pairwise multiple comparison procedure identified a significant difference between 1995 and 1999 ($Q=3.2$, $p<0.05$) and between 1995 and 2000 ($Q=3.0$, $p<0.05$). A significant difference was also identified during the Spring (Kruskal Wallis ANOVA,

H=26.57, d.f. 5, p<0.001) with Dunn's method identifying differences between 1995 and 1999, 1995 and 2000, 1998 and 1999, 1998 and 2000 (Q=3.0, Q=3.2, Q=3.3, Q=3.6, p<0.05).

For the abundance there was a significant difference in the mean values (Kruskal Wallis ANOVA, H=17.45, d.f. 5, p=0.004) (Figure 10) with the Dunn's method identifying differences between 1995 and 1999, 1995 and 2000 (Q=3.0, Q=3.0, p<0.05). Again there was a significant difference during the spring (Kruskal Wallis ANOVA, H=24.77, d.f. 5, p<0.001) with Dunn's method identifying differences between 1995 and 1999, 1995 and 2000, 1997 and 1999, 1997 and 2000, 1998 and 2000 (Q=3.3, Q=3.5, Q=3.1, Q=3.4, Q=2.9, p<0.05). There appears to have been a noticeable decline in numbers between the spring and the summer counts of 1998.

The decrease in numbers appears to have occurred in all habitats apart from the dam sites (Figures 11 and 12), although the only significant difference was with abundance within the mixed grassland/shrub habitat (Kruskal Wallis ANOVA, H=15.81, d.f. 5, p=0.007) with the Dunn's method identifying differences between 1995 and 1998, 1995 and 1999 (Q=3.0, Q=3.3, p<0.05).

Figure 11. The average (+/-) s.e.) number of species per site from five habitats, 1995-2000, Mulligans Flat Nature Reserve, ACT.

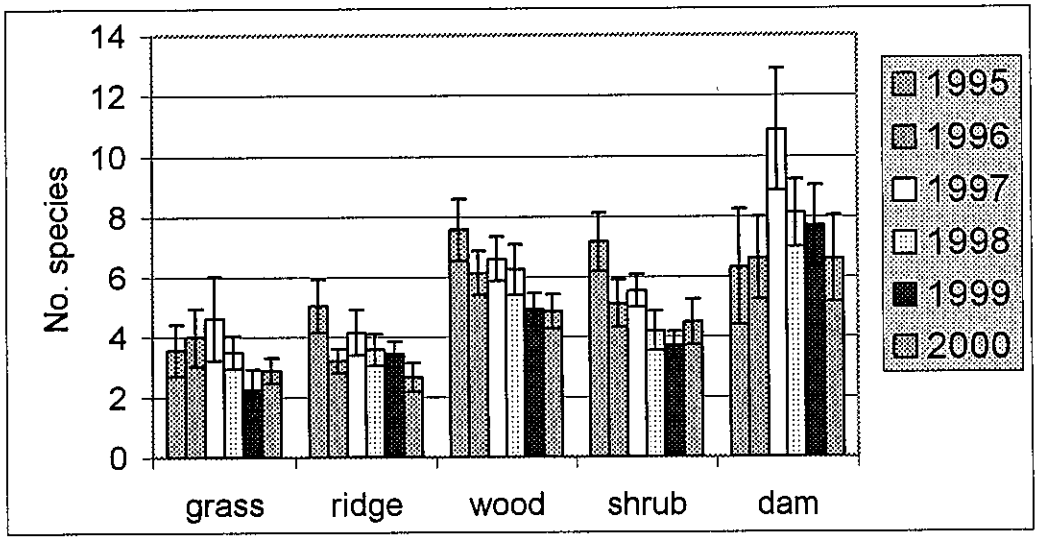
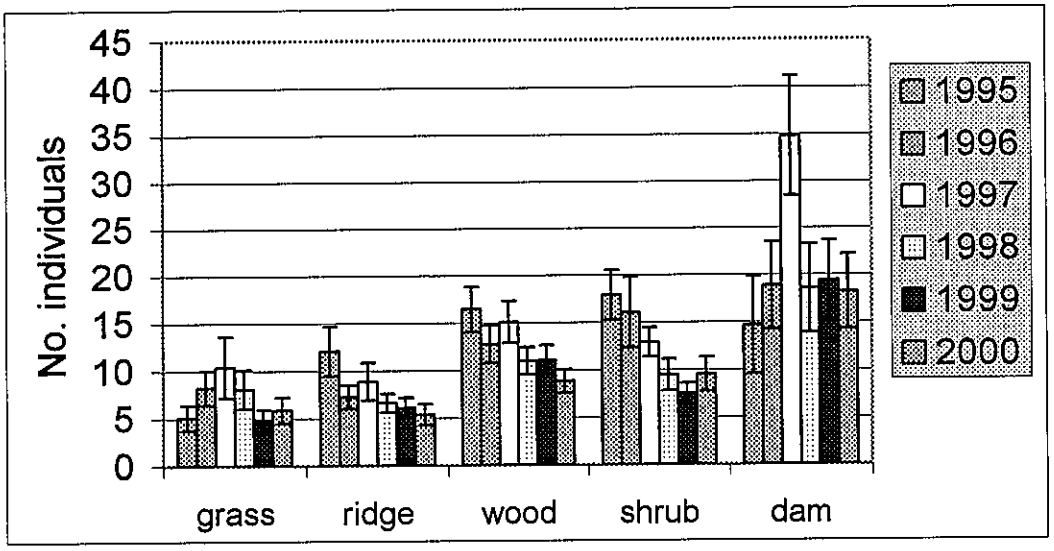


Figure 12. The average (+/-) s.e.) relative abundance per site, from five habitat types, 1995-2000, Mulligans Flat Nature Reserve, ACT.



Of interest is the large increase in numbers at the dam sites during the dry period of 1997, presumably associated with the dams at these two sites. Although the wall of the large dam at site 14 was breached in mid-July 1998 and not repaired until early 1999 there was no apparent reduction in bird numbers presumably because despite the breach the dam did not dry out completely.

Species prevalence, 1995-2000.

There were 104 species of woodland birds recorded at Mulligans Flat Nature Reserve during the survey period. Depending on their social behaviour, these species occur in flocks of various sizes. Therefore an appropriate way to measure the prevalence of a species is to compare the relative frequency of observation (reporting rate) rather than their relative abundance. The reporting rate, measured as the number of surveys in which a species is recorded therefore reflects how common a species is in a specific area or habitat.

The prevalence of the avifauna at Mulligans Flat is detailed in Appendix V. The prevalence is shown for individual sites, averaged for different habitats and averaged over all sites. The most commonly recorded species is the Buff-rumped Thornbill, recorded on average for 9 surveys within a plot, ranging from 22 of the 24 surveys at site 20 to a low of no surveys at sites 14 and 15. The second most common species was the Crimson Rosella followed by the Striated Pardalote. Of the 104 species recorded there were twenty that were not recorded within the plots, these species are listed as the final entries in Appendix V. Appendix VI details data rearranged from Appendix V to highlight the most common species in each habitat. Thus, the Buff-rumped Thornbill was the most common species in the ridge woodland and in the mixed grassland/shrub habitat, the Crimson Rosella was the most common species in the grassland and the open woodland whilst the Australian Magpie-lark was the most commonly recorded species at the dam sites.

It is also possible to determine the relative frequency of any one species within the various habitats, thus the Buff-rumped Thornbill, although the most common species overall and the most common species in the ridge woodland and the mixed grassland/shrub, is recorded more frequently in the mixed grassland/shrub than in the ridge woodland and least frequently in the dam habitat.

Many of the species at Mulligans Flat have habitat preferences and presumably a reduction in that habitat would affect the abundance of the species concerned. Conversely an increase in a particular habitat will increase the abundance. Grasslands appear to be of particular importance to the Weebill, Noisy Friarbird and Yellow-rumped Thornbill whilst the ridge woodland is important to the White-throated Treecreeper and the Striated Thornbill. The open woodland is important to the Grey Fantail, White-throated Treecreeper, Rufous Whistler, White-throated Gerygone and the White-winged Chough. The mixed grassland/ shrub is important to the smaller species such as the Buff-rumped Thornbill, Striated Thornbill, Weebill, Yellow-rumped Thornbill and the Superb Fairy-wren. The dam habitat appears to be important to many species including the Eastern Rosella, Sulphur-crested Cockatoo, Galah, Noisy Miner, Australian Magpie-lark, Superb Fairy-wren, Willie Wagtail, Common Starling, Dusky Woodswallow, Red-rumped Parrot and the Restless Flycatcher.

Changes in prevalence, 1995-2000

Over the six years of the survey there appears to have been a decrease in both species richness and abundance at Mulligans Flat. A significant change in abundance of an individual species is difficult to demonstrate because of the natural changes in abundance during the annual cycle and because the majority of species occur in small numbers. Even so a visual inspection of the abundance data for each species allows an assessment to be made (Table 3).

There does not appear to be any species that have obviously increased in numbers. Those that have declined are the Striated Thornbill, Rufous Whistler, Sulphur-crested Cockatoo, Yellow-rumped Thornbill, White-winged Chough, Brown Thornbill, and Brown-headed Honeyeater. Species that may have shown a decline are the Crimson Rosella, White-throated Treecreeper, Grey Shrike-thrush and the White-plumed Honeyeater. Species that occur in small numbers and have not been recorded for some time or have been recorded less frequently are the Superb Fairy-wren, Yellow Thornbill, Hooded Robin, Restless Flycatcher, Red-rumped Parrot, Brown Treecreeper, Painted Button-quail, Eastern Yellow Robin and the Double-barred Finch.

Eight species occur at Mulligans Flat in surprisingly low numbers considering their general distribution and the range of habitats available in the reserve. These are the Silvereye, White-plumed Honeyeater, Hooded Robin, Red-rumped Parrot, Common Bronzewing, Brown Treecreeper, Crested Pigeon, Jacky Winter and Diamond Firetail.

Comparison of the 1995-2000 survey with the 1986-1989 (Atlas) survey

The survey at Mulligans Flat during the period of data collection for the ACT Atlas (Taylor and Canberra Ornithologists Group 1992) was not conducted in the same way as the present survey. The major difference was that the area was surveyed by up to two observers covering the area over a three to four hour period and recording the

Table 3. Number of individual during each survey between 1995- 2000 at Mulligans Flat Nature Reserve, ACT.
Species listed in order of prevalence (see Appendix V).

Date	25 6 95	24 9 95	5 11 95	3 12 95	31 3 96	30 6 96	29 9 96	3 11 96	8 12 96	6 4 97	22 6 97	28 9 97	9 11 97	14 12 97	29 3 98	28 6 98	27 9 98	8 11 98	6 12 98	28 3 99	27 6 99	26 9 99	5 12 99	25 3 00	2 7 00	17 9 00
Common name																										
Buff-rumped Thornbill	31	22	45	33	22	29	69	35	24	18	44	28	31	38	27	37	34	24	29	30	37	17	12	33	25	19
Crimson Rosella	24	48	39	16	20	18	19	27	31	42	6	33	25	22	14	8	32	13	9	15	22	23	21	11	31	10
Striated Pardalote	4	38	11	6	18	4	18	15	13	12	6	29	7	14	9	0	17	4	0	4	12	11	7	25	3	15
Grey Fantail	0	21	5	10	21	0	18	11	11	13	0	31	4	14	34	0	23	8	3	13	2	13	13	13	1	3
Australian Magpie	11	12	3	25	14	15	11	13	11	13	7	15	7	13	3	7	22	10	16	23	8	11	26	12	1	13
White-throated Treecreeper	4	12	8	2	9	7	10	12	7	5	6	9	5	8	2	4	5	9	11	4	2	4	5	8	7	4
Striated Thornbill	14	26	38	15	9	30	29	10	37	28	14	23	11	25	0	10	12	18	13	12	18	9	6	10	9	14
Rufous Whistler	1	9	10	16	6	0	9	11	8	2	0	9	10	12	2	0	16	10	12	0	0	4	4	2	0	4
Weebill	13	10	7	8	5	2	6	4	10	7	26	23	5	10	21	16	15	1	3	4	9	2	4	12	8	8
Scarlet Robin	3	13	7	7	5	8	8	7	6	9	16	3	2	6	7	8	4	3	6	8	0	6	4	4	4	3
Noisy Friarbird	0	5	7	13	2	0	1	16	15	17	0	14	7	23	1	0	12	6	18	6	0	1	15	16	0	0
Spotted Pardalote	4	21	7	6	4	0	4	3	1	0	31	14	2	68	7	2	4	0	1	3	12	4	1	12	5	13
Eastern Rosella	8	10	22	4	5	14	8	17	8	15	2	19	14	13	6	4	7	6	5	7	6	4	4	0	1	18
Black-faced Cuckoo-shrike	0	13	8	11	5	0	0	16	7	6	0	10	11	6	0	0	8	9	6	4	0	9	11	1	0	2
White-throated Gerygone	0	6	4	7	0	0	3	11	10	0	0	7	7	10	0	0	14	8	9	0	1	3	5	1	0	2
Sulphur-crested Cockatoo	11	4	5	10	9	18	7	6	11	14	10	10	3	6	0	3	11	14	0	5	8	8	7	1	6	4
Galah	2	3	5	9	2	2	8	1	14	14	0	3	2	3	4	7	5	27	1	11	3	10	9	11	2	2
Yellow-rumped Thornbill	16	15	28	18	1	14	17	18	2	13	6	4	7	5	5	17	13	5	1	0	4	8	6	16	4	3
Noisy Miner	11	5	7	5	12	11	2	4	4	7	45	10	2	11	5	2	6	4	4	12	13	10	11	4	7	8
White-winged Chough	20	17	26	31	36	12	9	13	12	2	0	4	22	19	0	12	8	44	15	17	0	18	12	0	0	4
Brown Thornbill	10	6	3	3	1	3	7	3	0	3	3	6	3	5	3	1	3	0	0	0	2	1	1	1	3	2
Western Gerygone	0	6	5	6	0	0	4	11	1	0	0	6	1	2	0	0	3	2	3	0	0	5	0	0	0	4
Yellow-faced Honeyeater	2	9	0	3	0	2	13	5	1	18	0	12	2	0	0	0	12	1	0	0	1	3	0	2	1	6
Australian Raven	11	2	2	2	3	5	7	3	4	3	2	6	2	2	0	1	1	6	2	4	0	0	0	3	11	0
Australian Magpie-lark	6	7	6	8	9	0	2	3	0	5	2	2	6	0	0	2	3	3	2	2	1	2	2	4	0	9
Leaden Flycatcher	0	0	4	7	0	0	0	12	7	0	0	0	3	8	0	0	1	8	4	0	0	0	3	0	0	0
Olive-backed Oriole	0	0	3	4	2	0	1	3	4	0	0	2	3	4	0	0	4	2	4	0	0	2	4	0	0	4
Grey Shrike-thrush	1	3	3	2	2	0	1	1	3	0	3	3	4	5	1	1	1	2	1	1	0	0	0	1	0	2
Superb Fairy-wren	5	1	12	2	0	8	23	10	2	4	0	15	2	5	4	1	1	0	0	0	0	0	0	1	0	2
Laughing Kookaburra	0	3	0	6	5	2	5	2	1	1	0	0	4	7	0	1	0	7	0	2	4	2	3	0	0	1

Table 3 cont.

Date	25	24	5	3	31	30	29	3	8	6	22	28	9	14	29	28	27	8	6	28	27	26	5	25	2	17
	6	9	11	12	3	6	9	11	12	4	6	9	11	12	3	6	9	11	12	3	6	9	12	3	7	9
	95	95	95	95	96	96	96	96	96	97	97	97	97	97	98	98	98	98	98	99	99	99	99	00	00	00
Common name																										
Willie Wagtail	2	2	5	3	0	3	3	2	4	1	1	2	0	3	0	2	4	1	3	0	0	2	3	1	0	3
Brown-headed Honeyeater	6	11	1	3	3	0	8	7	7	5	8	8	0	5	0	0	4	10	0	0	0	0	1	4	0	0
Grey Currawong	2	2	2	3	2	0	3	1	0	0	0	0	3	1	0	2	3	1	1	1	0	2	2	3	0	0
Red Wattlebird	1	0	0	1	0	0	0	0	0	7	0	1	0	1	10	2	1	2	2	7	0	0	1	1	0	4
Golden Whistler	4	1	0	0	2	1	1	0	0	3	4	2	0	0	2	2	3	0	0	0	1	1	0	0	0	1
Common Starling	4	2	1	0	1	0	5	50	0	1	0	8	0	7	4	17	3	4	1	0	10	1	2	2	0	5
Yellow Thornbill	0	13	5	7	0	1	2	2	4	10	1	0	2	1	0	0	2	0	0	0	1	0	0	5	0	0
Pallid Cuckoo	0	12	5	0	0	0	1	2	0	0	0	1	3	0	0	0	0	2	0	0	0	2	0	0	0	0
Mistletoebird	0	0	0	4	0	0	0	0	5	0	0	0	2	1	0	0	2	2	0	0	0	3	5	1	0	0
Eastern Spinebill	6	2	0	1	2	3	0	0	0	1	1	1	0	2	0	1	0	0	0	1	0	0	0	3	2	1
Speckled Warbler	0	0	3	1	1	0	1	5	0	1	0	2	2	4	0	3	2	1	1	0	1	1	0	0	1	0
Grey Butcherbird	0	0	1	3	1	0	0	2	0	1	0	1	1	4	3	2	2	2	1	1	1	0	0	3	0	1
Silvereye	0	11	1	0	0	0	36	0	0	5	0	0	0	0	9	0	3	0	0	0	0	0	0	9	2	2
Pied Currawong	0	0	4	0	1	0	2	0	1	3	0	1	1	0	0	0	1	3	1	1	5	1	1	0	0	0
White-winged Triller	0	3	3	2	0	0	0	2	0	0	0	0	0	2	0	0	0	2	6	0	0	0	1	0	0	0
Sacred Kingfisher	0	0	2	4	0	0	0	0	5	0	0	0	0	1	0	0	0	3	7	0	0	0	3	0	0	0
Shining Bronze-Cuckoo	0	0	1	0	0	0	0	0	0	0	0	1	2	1	0	0	3	2	1	0	0	0	1	0	0	1
Varied Sittella	0	3	0	0	0	0	36	5	2	0	0	0	3	0	0	0	4	10	4	0	0	0	0	0	0	3
Dusky Woodswallow	0	0	5	0	2	0	0	2	2	0	0	2	2	0	0	12	0	0	0	0	0	0	2	0	0	1
White-plumed Honeyeater	0	0	0	1	3	1	0	2	0	0	1	0	0	0	0	0	2	0	1	0	0	0	0	0	5	0
Welcome Swallow	1	0	0	0	16	1	0	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	5	8	0	0
Hooded Robin	0	2	2	2	1	0	0	3	0	0	0	0	0	1	0	2	0	0	0	0	0	2	0	0	0	0
Horsfield's Bronze-Cuckoo	0	4	1	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1
White-naped Honeyeater	2	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	1	0	0	0	0	0	0	0	1	1
Restless Flycatcher	0	0	2	2	0	0	1	0	0	3	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Brush Cuckoo	0	0	0	1	0	0	0	1	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0
Rufous Songlark	0	0	2	3	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	2	0	2	5	5	0	0	0	0	1	0	8	0	0	0	0	0	0	0	0	0	0
Common Bronzewing	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Brown Treecreeper	1	3	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3 cont.

Date	25	24	5	3	31	30	29	3	8	6	22	28	9	14	29	28	27	8	6	28	27	26	5	25	2	17
	6	9	11	12	3	6	9	11	12	4	6	9	11	12	3	6	9	11	12	3	6	9	12	3	7	9
	95	95	95	95	96	96	96	96	96	97	97	97	97	97	98	98	98	98	98	99	99	99	99	00	00	00
Common name																										
Dollarbird	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	0	0	0	1	0	0	0
Crested Pigeon	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1
White-eared Honeyeater	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Painted Button-quail	0	0	1	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Eastern Yellow Robin	0	0	1	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Crested Shrike-tit	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Little Friarbird	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0
Double-barred Finch	0	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuscous Honeyeater	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whistling Kite	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Common Myna	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Gang-gang Cockatoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Superb Parrot	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacky Winter	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Diamond Firetail	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Raven	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collared Sparrowhawk	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-shouldered Kite	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree Martin	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

species present within an area of the present reserve that is included within the COG grid cell L10. From the 1995 to 2000 survey a sub-set of the data was taken which could be compared with the 1986-1989 survey. Data recorded from both inside and outside the circular plots from the thirteen sites located within L10 were identified and the reporting rate compared with the 1986-1989 data.

Because of the difference in survey methods the change in status of a species between the two periods has not been considered unless a species unique to either survey is recorded on more than four occasions. In addition the reporting rate of species recorded during each period must vary by 20% or more. Therefore, there needs to have been a substantial change in the reporting rate before species were regarded as having changed status.

Assuming that a true record of the species present has been recorded irrespective of the survey method then interesting differences in the reporting rate of some species emerge when comparing the reporting rate from within the area covered by grid cell L10 only.

During the course of the two surveys 113 woodland species were recorded. There were sixteen species recorded during the 1986-1989 survey that were not recorded within cell L10 during the 1995-2000 survey whilst fourteen species were recorded during the 1995-2000 survey but not during the 1986-1989 survey (Table 4). Of these 30 species only six were observed during more than four surveys. The November 1996 record of the Glossy Black Cockatoo is contentious. The observation is most likely that of a Yellow-tailed Black Cockatoo. Species that were surprisingly low in both surveys were the Jacky Winter, Southern Whiteface and the Flame Robin.

Table 4. Unique species and numbers of surveys within cell L10 from the 1986-1989 and the 1995-2000 surveys at Mulligans Flat Nature Reserve, ACT.

Common name	1986-1989	1995-2000
European Goldfinch	21	0
Richard's Pipit	9	0
Skylark	7	0
Tree Martin	6	0
Jacky Winter	4	0
Southern Whiteface	2	0
Golden-headed Cisticola	2	0
White-browed Woodswallow	2	0
House Sparrow	2	0
Common Myna	2	0
Peregrine Falcon	1	0
Tawny Frogmouth	1	0
Fork-tailed Swift	1	0
Fairy Martin	1	0
Flame robin	1	0
Regent Honeyeater	1	0

Common name	1986-1989	1995-2000
Grey Butcherbird	0	10
Brush Cuckoo	0	6
Double-barred Finch	0	3
Crested Pigeon	0	2
Peaceful Dove	0	1
Collared Sparrowhawk	0	1
Whistling Kite	0	1
Australian Hobby	0	1
Glossy Black-Cockatoo	0	1
Gang-gang Cockatoo	0	1
Little Corella	0	1
Australian King-Parrot	0	1
Australian Owlet-nightjar	0	1
Fuscous Honeyeater	0	1

Taking the six species that were unique to either survey and recorded for more than four surveys and the species that were recorded on 20% of occasions or more during either survey, then 22 species declined, 11 increased and there was no change for 40 of the species (Table 5).

The 22 species that have declined between the 1986-1989 and the 1995-2000 survey appear to have little in common, those that have declined the most are the White-plumed Honeyeater, Brown Treecreeper and European Goldfinch. Some species are insectivorous whilst some are granivorous or nectiverous. Some are solitary whilst others occur in flocks, some migrate others do not. Of interest is that 16 of the 22 declining species (73%) obtain all or most of their food from on or very close to the ground.

The eleven species that have increased also appear to have little in common, with the Olive-backed Oriole, Yellow Thornbill and Eastern Spinebill having increased the most.

Observations on breeding

Since 1986 when members of the Canberra Ornithologists Group started to survey the avifauna of Mulligans Flat, according to the COG database 48 species have been recorded breeding within the area. From a diary maintained for each visit during the 1995-2000 surveys an additional six species have been noted as breeding (see Appendix VII for a total list).

For the 1995-2000 survey, species seen breeding were recorded as each site was surveyed. In addition any bird seen breeding whilst observers moved between sites was also noted. For the 1986-1989 survey breeding observations were recorded as the observers covered the L10 cell. Breeding was recorded when birds were seen to inspect nest hollows, carry nest material or food, display, copulate, nest build, sit on eggs or when adults were seen with young. In addition if a nest with eggs or with young were found the species was recorded as breeding. All records were obtained on an opportunistic basis rather than as a thorough investigation of all potential nesting locations. Therefore, the observations cannot be regarded as a definitive comment on the breeding birds of the area.

Not including the breeding notes taken from the diary, 30 species were recorded as breeding during the 1986-1989 survey and 36 species during the 1995-2000 survey (Table 6). Eighteen species were observed breeding during both of the surveys, so of the 48 species, twelve (25%) were recorded as breeding in 1986-1989 but not in 1995-2000 whilst 18 (38%) were recorded as breeding in the 1995-2000 survey but not in 1986-1989. This difference is not due to the fact that the breeding records for the 1995-2000 survey came from a larger area than the previous survey. Removing those breeding records from outside cell L10 only reduced the number of 1995-2000 breeding species by one (Weebill).

Table 5. Change in reporting rate for species recorded in cell L10 during the 1986-1989 and the 1995-2000 survey at Mulligans Flat Nature Reserve, ACT. Reporting rate of a species measured as -(no. of 1986-89 surveys species recorded for/ total number of 1986-89 surveys) + (no. of 1995-00 surveys species recorded for/ total number of 1995-00 surveys).

Common name	Family	1986-1989	1995-2000	change	status
White-plumed Honeyeater	Meliphagidae	25	3	-0.88	decline
Brown Treecreeper	Climacteridae	22	1	-0.84	decline
European Goldfinch	Fringillidae	21	0	-0.84	decline
Willie Wagtail	Dicruridae	25	10	-0.62	decline
Common Starling	Sturnidae	25	13	-0.50	decline
Speckled Warbler	Pardalotidae	21	10	-0.46	decline
Common Bronzewing	Columbidae	14	3	-0.44	decline
Red-rumped Parrot	Psittacidae	13	2	-0.44	decline
Welcome Swallow	Hirundinidae	13	2	-0.44	decline
Hooded Robin	Petroicidae	12	1	-0.44	decline
Australian Magpie-lark	Dicruridae	25	16	-0.38	decline
Superb Fairy-wren	Maluridae	25	16	-0.38	decline
Richard's Pipit	Motacillidae	9	0	-0.36	decline
Diamond Firetail	Passeridae	9	1	-0.32	decline
Eastern Rosella	Psittacidae	25	18	-0.31	decline
Noisy Miner	Meliphagidae	21	14	-0.30	decline
Skylark	Alaudidae	7	0	-0.28	decline
Crested Shrike-tit	Pachycephalidae	7	1	-0.24	decline
Little Raven	Corvidae	7	1	-0.24	decline
Tree Martin	Hirundinidae	6	0	-0.24	decline
Grey Shrike-thrush	Pachycephalidae	24	19	-0.23	decline
Brown Falcon	Falconidae	6	1	-0.20	decline
Yellow-rumped Thornbill	Pardalotidae	25	21	-0.19	no change
Brown Goshawk	Accipitridae	9	5	-0.17	no change
Rufous Songlark	Sylviidae	7	3	-0.16	no change
Little Friarbird	Meliphagidae	6	2	-0.16	no change
Dusky Woodswallow	Artamidae	6	3	-0.12	no change
White-winged Chough	Corcoracidae	22	20	-0.11	no change
White-naped Honeyeater	Meliphagidae	8	6	-0.09	no change
Eastern Yellow Robin	Petroicidae	5	3	-0.08	no change
Weebill	Pardalotidae	25	24	-0.08	no change
Grey Fantail	Dicruridae	22	21	-0.07	no change
Black-faced Cuckoo-shrike	Campephagidae	21	20	-0.07	no change
Horsfield's Bronze-Cuckoo	Cuculidae	7	6	-0.05	no change
Sulphur-crested Cockatoo	Cacatuidae	25	25	-0.04	no change
Galah	Cacatuidae	23	23	-0.04	no change
Western Gerygone	Pardalotidae	17	17	-0.03	no change
Shining Bronze-Cuckoo	Cuculidae	10	10	-0.02	no change
Leaden Flycatcher	Dicruridae	10	10	-0.02	no change
White-winged Triller	Campephagidae	7	7	-0.01	no change
Silvereye	Zosteropidae	6	6	-0.01	no change
Crimson Rosella	Psittacidae	25	26	0.00	no change
Buff-rumped Thornbill	Pardalotidae	25	26	0.00	no change
White-throated Treecreeper	Climacteridae	25	26	0.00	no change
Australian Magpie	Artamidae	25	26	0.00	no change
Striated Thornbill	Pardalotidae	24	25	0.00	no change
Australian Raven	Corvidae	24	25	0.00	no change
Brown Thornbill	Pardalotidae	21	22	0.01	no change
Noisy Friarbird	Meliphagidae	18	19	0.01	no change
Brown-headed Honeyeater	Meliphagidae	14	15	0.02	no change

Common name	Family	1986-1989	1995-2000	change	status
Varied Sittella	Neosittidae	6	7	0.03	no change
White-eared Honeyeater	Meliphagidae	5	6	0.03	no change
Scarlet Robin	Petroicidae	24	26	0.04	no change
Striated Pardalote	Pardalotidae	24	26	0.04	no change
Yellow-faced Honeyeater	Meliphagidae	15	17	0.05	no change
Fan-tailed Cuckoo	Cuculidae	6	8	0.07	no change
Rufous Whistler	Pachycephalidae	17	20	0.09	no change
Little Eagle	Accipitridae	2	5	0.11	no change
Laughing Kookaburra	Halcyonidae	19	23	0.12	no change
Mistletoebird	Dicaeidae	9	13	0.14	no change
White-throated Gerygone	Pardalotidae	13	18	0.17	no change
Pallid Cuckoo	Cuculidae	8	13	0.18	no change
Spotted Pardalote	Pardalotidae	20	26	0.20	increase
Grey Currawong	Artamidae	15	21	0.21	increase
Golden Whistler	Pachycephalidae	7	13	0.22	increase
Sacred Kingfisher	Halcyonidae	3	9	0.23	increase
Brush Cuckoo	Cuculidae	0	6	0.23	increase
Red Wattlebird	Meliphagidae	5	12	0.26	increase
Pied Currawong	Artamidae	10	19	0.33	increase
Grey Butcherbird	Artamidae	0	10	0.38	increase
Eastern Spinebill	Meliphagidae	6	17	0.41	increase
Yellow Thornbill	Pardalotidae	2	13	0.42	increase
Olive-backed Oriole	Oriolidae	3	15	0.46	increase

Table 6. Breeding woodland bird species at Mulligans Flat, 1986-1989 and 1995-2000. All records from cell L10 except where indicated (*).

	1986-87	1987-88	1988-89	1995-96	1996-97	1997-98	1998-99	1999-00
Brown Goshawk		1						
Sulphur-crested Cockatoo								1
Superb Parrot					1			
Crimson Rosella				1		1	1*	
Eastern Rosella			1		1*	1	1	
Laughing Kookaburra			1			1		
Sacred Kingfisher				1			1	1*
Grey Fantail						1		
Willie Wagtail		1	1	1				
Leaden Flycatcher				1	1	1	1	1
Restless Flycatcher			1					
Jacky Winter				1				
Scarlet Robin	1	1	1		1			
Hooded Robin	1	1	1	?	1		1	
Rufous Whistler		1	1		1			
Grey Shrike-thrush		1						
Australian Magpie-lark		1	1			1	1	1
Crested Shrike-tit	1							
Black-faced Cuckoo-shrike			1					
White-winged Triller	1		1					
White-throated Gerygone				1			1	
Western Gerygone								1
Weebill		1					1*	
Striated Thornbill		1			1			1*
Buff-rumped Thornbill	1		1		1	1	1	1
Yellow-rumped Thornbill	1	1	1	1	1		1*	1*
Speckled Warbler			1	1				
Superb Fairy-wren			1					
Dusky Woodswallow			1					
Varied Sittella							1	
Brown Treecreeper		1						
White-throated Treecreeper		1		1		1		
Mistletoebird							1	
Spotted Pardalote						1		
White-plumed Honeyeater	1							
Noisy Miner			1					
Noisy Friarbird		1	1	1	1	1	1	1
Little Friarbird				1	1		1	
Diamond Firetail	1							
Olive-backed Oriole					1*		1	1
White-winged Chough	1		1	1	1	1	1	1
Grey Currawong			1		1	1		
Pied Currawong					1			
Grey Butcherbird						1	1	
Australian Magpie	1	1	1	1	1	1	1	1
Australian Raven							1	
Striated Pardalote				1				
Common Starling			1		1*		1	

Unfortunately neither survey was conducted in a way to satisfactorily quantify breeding success from year to year but they do allow a comparison between surveys for the presence of breeding by individual species.

During the 1995-2000 survey breeding species included the abundant Australian Magpie, Buff-rumped Thornbill, White-winged Chough and Noisy Friarbird. The most unexpected record was that of the Superb Parrot but the observation was of a bird inspecting a hollow and there was no observations of successful breeding. Two Speckled Warbler breeding observations in 1995-96 were of dependent young as were the Hooded Robin breeding observations of 1996-97 and again in 1998-99.

Of most interest are those species recorded breeding during the three breeding seasons of the Atlas survey but not recorded breeding within the cell L10 during the five breeding seasons of the 1995-2000 survey. The White-plumed Honeyeater, White-winged Triller, Dusky Woodswallow, Superb Fairy-wren and Restless Flycatcher were recorded nesting whilst the Crested Shrike-tit, Diamond Firetail, Brown Treecreeper, Grey Shrike-thrush, Noisy Miner and Black-faced Cuckoo-shrike were observed with dependent young. The Hooded Robin although only recorded with dependent young in the 1995-2000 survey was recorded as carrying food or with dependent young in 1986-87 and 1987-88 and as a nest with eggs in 1988-89.

Threatened species at Mulligans Flat.

Of the six bird species listed as threatened within the ACT, four have been recorded at Mulligans Flat. The Brown Treecreeper was recorded from 22 surveys within cell L10 between 1986 and 1989 yet only once within the same area in 1995-2000 although it was also recorded on seven other occasions but from sites outside L10. From the 1995-2000 survey the preferred habitat appeared to be the open woodland (Table 7). The Hooded Robin was recorded on 12 surveys from L10 between 1986 and 1989 and only once from L10 during the 1995-2000 survey although it was also recorded on eight other occasions but from outside cell L10. The preferred habitat was the mixed grassland/shrub habitat. The Regent Honeyeater was recorded once only during the 1986-1989 survey but not at all during the 1995-2000 survey. In December 1998 two Regent Honeyeater were reported near site 2 (J.Bounds *pers. comm.*) but these sightings were outside the survey period and for some unknown reason not recorded on the COG Mulligans Flat database. Conversely the Superb Parrot was recorded once during the 1995-2000 survey but not during the 1986-1989 survey.

Table 7. All records of threatened species at Mulligans Flat Nature Reserve, ACT, 1995-2000. (*) records from within cell L10.

Common name	Date	SiteNumber	Habitat	Total no.
Brown Treecreeper	25/06/1995	8*	ridge	1
Brown Treecreeper	24/09/1995	14	pondage	1
Brown Treecreeper	24/09/1995	13	woodland	2
Brown Treecreeper	3/12/1995	14	pondage	1
Brown Treecreeper	9/11/1997	13	woodland	1
Brown Treecreeper	28/06/1998	13	woodland	1
Brown Treecreeper	8/11/1998	17	woodland	1
Brown Treecreeper	27/06/1999	15	woodland	2
Hooded Robin	24/09/1995	22	shrub	2
Hooded Robin	5/11/1995	11	woodland	1
Hooded Robin	5/11/1995	1	woodland	1
Hooded Robin	3/12/1995	22	shrub	2
Hooded Robin	31/03/1996	23*	shrub	1
Hooded Robin	3/11/1996	21	shrub	3
Hooded Robin	14/12/1997	21	shrub	1
Hooded Robin	28/06/1998	21	shrub	2
Hooded Robin	26/09/1999	21	shrub	2
Superb Parrot	3/11/1996	13	woodland	1

WATERBIRDS

Two sites were surveyed to examine the effects of dams on the species diversity of the immediate area. Site 2 contained a typical small farm dam whilst site 14 contained a much larger dam (Figure 2a). Both sites were situated within the open woodland habitat. In addition to the woodland birds these two sites, not unexpectedly recorded virtually all of the observations on waterbirds. Twenty-seven waterbird species were recorded during the 1995-2000 survey, twenty-one were recorded from within the plots at these two sites whilst the remaining six species were observed outside the plots. Site 14 with the much larger dam recorded many more species than the site with the smaller dam (Table 8). This was probably due not only to dam size but also to the large number of dead trees standing in the dam.

Table 8. Number of surveys (maximum 26) that waterbirds were recorded for two dam sites, Mulligans Flat Nature Reserve, ACT, 1995-2000.

Common name	Site 2	Site 14
Little Pied Cormorant	1	18
Grey Teal	0	15
Australasian Grebe	2	13
Pacific Black Duck	2	12
Maned Duck	5	9
Eurasian Coot	0	8
Black-fronted Plover	0	8
Masked Lapwing	0	7
Little Black Cormorant	0	5
Australian Shelduck	0	5
Australasian Shoveler	0	5
Hardhead	0	5
Hoary-headed Grebe	0	4
White-faced Heron	0	4
Pacific Heron	0	3
Musk Duck	0	3
Great Cormorant	0	2
Darter	0	2
Sacred Ibis	0	2
Black Swan	0	2
Rufous Night Heron	0	1

Discussion

With the declaration of Mulligans Flat as a Nature Reserve under the ACT Canberra Nature Park in 1994 the management of the surrounding area has experienced significant changes. From a management regime that involved some clearing for agriculture in the 1800s to stock grazing and pasture improvement in the last century the area has recently been subject to stock removal, and a policy of low maintenance that allows regeneration of much of the remaining habitat.

Habitat changes

COG collected data systematically over two periods, firstly from 1986 to 1989, during the collection phase of the ACT Bird Atlas project, and again from 1995 to the present. The value of these surveys is that they are able to highlight some possible long-term changes to the avifauna of the area but unfortunately this cannot be readily related to changes in habitat for there is no long-term data that allows any changes to be identified at a level that is significant to the avifauna of the area.

Birds are useful indicators of biological diversity (Morrison 1986, Freudenberger 1999) and they can be used to ensure that management policies do not reduce biological diversity. They can be used in association with other management tools to designate areas of land use and thus define various zoning practices. In addition threatened species and communities can be identified for special management considerations.

Although photographs of the various survey sites were taken in 1995, for instance (Figures 2a-2e) and again in 2000 any changes that may have occurred over this short period are difficult to interpret but undoubtedly the value of the photographs and of the habitat assessment conducted in 2000 will increase with time.

Despite this, visual impressions indicate that the change of management and the likely reduction in rabbit numbers due to the arrival of Rabbit Haemorrhagic Virus Disease to the district in 1996, has resulted in an increased biomass of vegetation, particularly grasses and thatch at the ground layer, a recovery of shrubs from browsing pressure and an increased abundance of fallen timber. Although there is plenty of eucalypt regeneration in the area, it is of interest that Lepschi (1993) quite clearly comments on the eucalypt regeneration that was occurring before the management changes in 1994.

Habitat assessment

At the start of the 1995 survey the location of sites was determined by a quick visual impression of the habitat taking into account the vegetation and the topography. The habitat assessment conducted in late 2000 appears to confirm that the decisions made in 1995 were correct. The problem of developing an assessment procedure that allows for the ranking of sites is that there needs to be a balance between including all of the essential habitat elements that are needed to assess the various components used by birds yet arrive at a unique score that reflects habitat complexity.

Although as expected there is much variation between sites the average score for the open woodland habitats (13.3) was the highest. The mixed grassland/shrub score of 11.6 is lower because the greater weighting provided by the eucalypt regeneration and the tree hollows is not compensated for by the high short shrub rating of the shrub habitat. Not surprisingly the grassland produced the lowest structural score.

The assessment satisfactorily indicates the higher canopy cover, eucalypt regeneration, tall shrubs, ground layer and tree hollows of the open woodland sites (Figure 2b), the high tall and short shrubs and ground layer of the mixed grassland/shrub sites (Figure 2c) and the high canopy cover, eucalypt regeneration and fallen timber but low shrub and ground cover of the ridge sites (Figure 2d). All sites had similar tree health and all showed a low mistletoe count. Not only does the individual score of the various attributes reflect the differences in the structural components of the habitats, the total score reflects the number of species, their abundance and the diversity score of all habitats except for the dam. This is not surprising considering that the assessment was not designed with the dam habitat in mind.

Richness

The seven open woodland sites recorded in total and on average a greater number of species than did the mixed grassland/shrub sites but the difference was not significant. Although sites were set up prior to the declaration of the endangered Yellow Box/Red Gum grassy woodland community the seven open woodland sites do represent this community and it is worth noting that it was the endangered community that recorded the richest bird assemblage of the area although there were no species unique to this habitat. Both the ridge woodland and the grassland contained a significantly lower number of species. Of interest is the two dam sites. Site 2, with the smaller dam

situated within the open woodlands, had a similar number of species to the open woodland sites whilst site 14, with the much larger dam situated in open woodland, recorded on average the largest number of species, thus highlighting the importance of dam size on the woodland avifauna of the area. In addition many more waterbird species were attracted to the larger dam. Whether this was due to size *per se* or due to the presence of a large number of standing dead trees in the dam is unknown.

Species richness and abundance of the woodland birds varied between the two sites with site 2 having a similar richness and abundance to the other seven woodland sites but site 14 contained nearly twice the number of species at nearly double the abundance. Interestingly though site 2 had the highest diversity index. Woodland species that were particularly abundant included the Eastern Rosella, Willie Wagtail, Galah, Sulphur-crested Cockatoo, Noisy Miner, Common Starling, Dusky Woodswallow, and Red-rumped Parrot with the Australian Magpie-lark being particularly common at both dam sites.

Species prevalence

The annual migration of birds into and out of the ACT is well known (Frith 1984, Taylor and Canberra Ornithologists Group 1992) and this is shown for many species by the results of the Canberra Ornithologists Group's Garden Bird Survey (Fennell 2000). Many species arrive in the early spring to breed within the ACT and region then to depart again during the autumn months whilst some species appear in the region during the autumn to overwinter. In some cases the entire population moves, in others only part of the population moves and the numbers can vary from year to year. In general though, a pattern of higher species richness and abundance during the spring and summer months followed by a decline in the autumn and winter would be expected.

This is well demonstrated by the data from Mulligans Flat between 1995 and 1998. The dry period throughout 1997 and for six months into 1998 did not appear to affect bird numbers. During 1999 and 2000 though there appears to have been a reduction in both species richness and abundance and this was noticeable during the 1999 breeding season and up to September of the 2000 breeding season. The decline was particularly noticeable between the spring and summer of 1998. On further examination the average number of species recorded from a site and their abundance declined from 1995 to 2000 and although the decline was particularly marked in the number during the spring and summer there was also a decline in the autumn and winter. Again both richness and abundance appear to have declined irrespective of habitat but especially in the open woodland and the mixed grassland/shrub.

In summary, there appears to have been a decline in numbers during the course of the survey, this decline has occurred in all habitats and in all seasons. There was a decline in seven species with a further four whose decline is questionable. In addition a further nine species which occur in small numbers were seen less frequently.

Although difficult to compare because of differences in the way the birds were counted, there have been changes in the avifauna between 1986-1989 conducted before the change of management and the present. Rigorous effort was made to make the results comparable for the two surveys. For those species whose reporting rate has

varied by more than 20% between surveys there has been an increase in 11 species and a decrease in 22 species. The most noticeable decliners were the White-plumed Honeyeater, Brown Treecreeper and European Goldfinch. Of those species that were recorded in four surveys or less, there were 12 species recorded in 1986-1989 yet not recorded in the present survey and 12 species not reported in the 1986-1989 survey but recorded in the present survey. The above species may not have been recorded because of their low occurrence, but they have been noted as species of interest.

Those species that have declined between the two survey periods include the Brown Treecreeper and the Hooded Robin, both listed as vulnerable within the ACT. In addition three species, Speckled Warbler, Diamond Firetail and Crested Shrike-tit are listed as declining in the New South Wales sheep-wheat belt (Reid 1999). There was one species listed as vulnerable, (Superb Parrot), one species listed as endangered, (Regent Honeyeater) and two species listed as declining (Jacky Winter, Southern Whiteface) by Reid that were recorded from Mulligans Flat during one of the surveys but on less than four occasions.

The reporting rate of the Cuculidae, Order Cuculiformes (Cuckoos) has not decreased for any species with four species remaining stable and one increasing. Within the Psittaciformes the two species of Cacatuidae (Cockatoos) remained stable although one (Sulphur-crested Cockatoo) appears to have declined during the 1995-2000 survey whilst of the Psittacidae (Parrots) two have decreased and one remained the same. Of the 57 Passeriformes one of the Pardalotidae (Pardalotes) has declined, eight remained stable and two increased although four of the stable species showed a decline during the 1995-2000 survey. With the Meliphagidae (Honeyeaters) two have declined, six remained stable and two increased. Of the Petroicidae (Robins) one declined and two remained stable although in the 1995-2000 survey one of the stable species showed a decline. For the Pachycephalidae (Whistlers, Shrike-tit and Shrike-thrush) two decreased, one remained stable and one increased although the one stable showed a decline in the 1995-2000 survey. Within the Dicruridae (Flycatchers) two decreased and two remained stable whilst of the Artamidae (Woodswallows, Butcherbirds, Magpie) two remained stable and three increased. There were three Families (Fringillidae, Sturnidae and Alaudidae) that were represented by introduced species and all showed a decline. Of the remaining Passeriformes eight species declined, seven remained stable and two increased.

Possible reasons for decline

Ford *et al.* (2001) discuss the reasons why woodland birds have declined in southern Australia. Hypotheses that could account for the declines of species in the agricultural region are listed as follows:

Habitat loss.

Random extinctions due to sampling effects.

Disproportionate loss of specific habitats, affecting habitat specialists and mobile species.

Habitat fragmentation.

Reduced dispersal due to patch isolation.

Edge effects leading to increased nest predation from open-country species and reduced food availability.

Habitat degradation.

Increased competition from aggressive species.
Reduced availability of nest sites due to loss of mature trees and shrubs leading to increased nest predation.
Increased number of nest predators.
Increased predation of adults and juveniles, especially by exotic predators.
Increased mortality from human activities and utilities.
Increased level of nest parasitism.
Reduced food abundance due to grazing, altered fire regime and habitat simplification.

With the large number of partial or complete migrants that do not spend the entire year within the region any decline in numbers may well be caused by reasons listed above, but they occur outside the local region and have nothing to do with Mulligans Flat. But, of the 22 species that have declined between 1986-1989 and 1995-2000 and the additional seven species that show declined during the 1995-2000 survey, 86% remain in the area throughout the year. It is thus most likely that the reasons for decline occur within the local region.

There does not appear to have been any major habitat degradation at Mulligans Flat for many years. The last time that timber was cleared from the reserve was in early 1971 when the lessee was granted permission to clear timber on specific area to enable the establishment of pasture (Lindenmayer 1992). Since then, there has been no obvious recent tree clearing and the last fire to go through the area was February 1979 . Thus, prior to the establishment of the reserve in 1994 the habitat appears to have remained in a relative stable condition affected only by the fluctuating weather and stocking densities. Most of Australia's birds are long-lived so small populations may persist in remnants for long periods before disappearing (Ford *et al.* 2001). Although any changes in the habitat may have consequences for the avifauna for many years to come, it is unlikely that the decline at Mulligans Flat is due to any recent habitat perturbations prior to 1986.

Since 1994 there has been no disproportionate loss of specific habitats, no increased patch isolation and no increase in edge effects. Increased competition from aggressive species is unlikely for the Noisy Miner is virtually restricted to site 14 around the large dam and to nearby site 15 and then indications are that they may have declined since 1986-1989. The Noisy Friarbird, another aggressive competitor occurs as a breeding migrant and is not present throughout the year whilst the Red Wattlebird occurs in small numbers.

It is unlikely that there has been a reduction in the availability of nest sites due to tree loss as there has been no habitat clearing whilst human activity is likely to be similar to the pre-reserve area. There is no measure of nest parasitism but there does not appear to have been any increase of the cuckoo populations in the area.

Removal of natural vegetation will lead to a loss of a similar proportion of individuals from a population and so through the effects of random sampling a few species will disappear (Ford *et al.* 2001). Although undoubtedly bird assemblages of the area has in the past declined due to random sampling effects brought about by decreasing amounts of remnant vegetation, there has been no significant clearing of native habitat within the local region apart from the replacement of already modified agricultural grazing land with suburbia. At present suburbia is slowly approaching the southern boundary with the suburb of Amaroo now being built less than 1 km away. Because of the habitat preferences of the declining species, unless past habitat clearances are still causing species decline it is unlikely that the replacement of modified agricultural land for housing are affecting bird numbers at Mulligans Flat.

The 1995-2000 survey was undertaken by members of COG. The expertise of the volunteers could vary specially in the ability to identify species by their calls. There is a possibility that the observers during the latter part of the survey were less experienced than those who participated at the start. Over the period there were 50 observers of which 50% surveyed once or twice only, whilst 50% of the remainder were involved in the majority of surveys. The observers of the final three surveys had on average already been involved in 12 previous surveys, therefore, there was a consistent core of observers that were involved throughout the surveys so it is unlikely that the decline can be explained by a decline in observer expertise.

The decline could be explained by a natural variation that occurs with numbers within the local bird assemblage, but this would only be known after many more years of observations. The dry period during 1997 and for the first half of 1998 may be responsible for the decrease in numbers. The 1997-98 breeding season may have been affected by the dry period causing poor recruitment leading to the subsequent decline. Brooker and Brooker (1994) have shown that quite large isolated populations may not be sustainable over the long-term and that events such as drought can make losses and declines more likely. Davey (*pers. obs.*) has observed the decline of species during a drought with a return to near original numbers taking some years.

If drought, natural variation or survey techniques are responsible the present management of the reserve has nothing to do with the decline in numbers. On the other hand, there are changes that may have happened since the change in management practices in 1994. The removal of domestic stock grazing pressure may have caused an increase in the density and height of the ground herbage. At the same time ground predators may have increased. COG has not systematically collected data on ground predators, but *ad hoc* observations suggest that foxes are common. Although no cats appear to have been seen on occasions as many as five separate observer groups reported seeing foxes during a single survey, on one occasion a group observing a fox with four cubs. These observations agree with Fischer (1999) who recorded fox, but no cats in the area.

Thirty-nine percent of species to be found at Mulligans Flat feed on or very close to the ground. Yet, interestingly, of the 22 species that may have declined, 73% obtain all or part of their food from on or very close to the ground. If the additional 13 species that appear to have declined during the 1995-2000 survey are included then the number of declining ground feeding species is 68%. Thus, a possible explanation for a

decline in some of the species may be associated with an increased ground herbage and/or an increase in the number or hunting efficiency of ground predators.

This does not explain why the resident White-plumed Honeyeater has experienced such a decrease although interestingly the species decline has also been recorded in the COG's Garden Bird Survey (Fennell 2000). Goldfinch are usually associated with dense thistle patches as they feed on the thistle seeds. A possible reason for their decline may therefore be due to a decrease in thistle density caused by a different grazing regime brought about by the removal of domestic stock.

Paradoxically, a recent report produced by Birds Australia suggests that on farms where much of the ground cover had been reduced to well grazed pastures, bird diversity is reduced by 25% (Barrett 2000) yet the Mulligans Flat data suggests that a possible reason for the decline in numbers is due to the re-establishment of a rank, tall herbage layer with a resulting increase in thatch. Barrett *et al.* (1994) suggest that the majority of species that depend on the ground for nesting or foraging are particularly sensitive to habitat changes.

Although some species have declined in numbers others have increased. It is difficult to identify any common features with the 11 species that have increased although the Golden Whistler, Eastern Spinebill, Red Wattlebird and Olive-backed Oriole have also been identified as increasing in the COG's Garden Bird Survey (Fennell 2000). They may increase further as suburban gardens encroach closer to the reserve boundary.

In conclusion, the survey at Mulligans Flat suggests that between 1995 and 2000 there has not been an increase in the abundance of any species, although when compared with the 1986-1989 survey there has been an increase in the abundance of eleven species with an additional twelve species not having been recorded in 1986-1989. At the same time there has been a possible decrease of seven species with an additional 22 recording a decrease in abundance between the 1986-1989 and the 1995-2000 survey and an additional 12 species not recorded in the 1995-2000 survey. Reasons are discussed for the changes and it appears most likely that much of the modification in the avifauna of the area has occurred with changes brought about since the declaration of the area as a reserve in 1994.

Even though it appears that some species have declined and others increased it must be stressed that Mulligans Flat is still a most highly valued area for birds of the local region. Mulligans Flat contains all of the attributes required to maintain high biodiversity. The area is large, relatively undisturbed and contains different habitat types which are complex with marked variation in patchiness. This is important so that the area can resist disturbance and maintain its internal dynamics; features not found in other ACT woodland sites.

Freudenberger (1999) notes that 'conservation of large (>100 ha) and structurally diverse woodland remnants (abundant ground cover, a mixture of low shrub, middle-sized shrubs and wattles and eucalypt overstorey) is a high priority for vulnerable woodland birds', all features that are presently provided by the Mulligans Flat Nature Reserve.

Recommendations

The report suggests that between 1986 and 2000 there may have been an increase in the abundance of eleven species and a decrease in the abundance of 29 species. In the case of the seven species that have declined between 1995 and 2000 the decline appears to have happened since the summer of 1998 and has occurred irrespective of habitat or season. Possible reasons for the declines are discussed, the most important of which is that the survey has done no more than detect natural fluctuations in the assemblage of birds at Mulligans Flat or it has highlighted real changes in the abundance of some species. This can only be resolved by continuing with the surveys using the same protocol that has been used over the past six years.

The surveys at Mulligans Flat must continue to not only provide data as an indicator of the success of management practices by the Parks and Conservation Service of Environment, ACT but also to provide data to the larger Yellow Box/Red Gum grassy woodland survey conducted at present by members of COG. In addition as suburbia continues to encroach upon the southern boundary the survey will monitor the inevitable increases in disturbance which may well result in changes to the bird community at Mulligans Flat. It is therefore recommended that the 24 sites continue to be surveyed and that no consideration be given to reducing the number to the seven open woodland sites only to bring Mulligans Flat in line with the other sites being presently monitored by COG for the Yellow Box/ Red Gum grassy woodland survey.

Broad-scale surveys of the type that can be conducted by amateur bird groups such as COG are able to provide information on the temporal and spatial variation of the common birds of the area and as such any decline or increase in numbers of species can be used as an indicator of the success of management practices in the area. Unfortunately though, managers are also concerned with those species that are threatened and these invariably occur in small numbers and their distribution is patchy. These attributes make it difficult to accurately monitor distribution and abundance with broad-scale surveys To monitor threatened species it usually requires different survey techniques which in most cases would involve methods specially designed for the species of concern. The type of surveys that can be conducted by bird groups can only provide a general trend of what is occurring in the area. Surveys can highlight those species that may require specific attention. Thus, to adequately monitor the populations of the threatened species within Mulligans Flat now requires different techniques that cannot be provided by amateur bird groups but can be provided by dedicated individuals involved in single-species studies.

The present survey protocol needs to be continued, but consideration needs to be given to randomise observers to the sites rather than particular observers surveying their preferred sites. Any suggestion to increase the size of the plots and survey for 20 minutes to bring the survey protocol in line with the Birds Australia Atlas project will either double the survey time or reduce the number of survey sites, thus increasing the variability. Any changes in species numbers will therefore need to be of a greater magnitude to be regarded as statistically significant.

Consideration needs to be given to improve the information on bird breeding, abundance of ground predators and vegetation changes. To improve on the bird

breeding information consideration should be given to replacing the November survey with a survey designed to specifically obtain breeding information. The survey must collect data that provides more than a list of breeding species. It must be designed so that an assessment can be made of the relative importance of each habitat to the breeding success of species. Ideally the survey should be conducted twice during a breeding season to allow for yearly differences in the timing of the breeding season.

Data on ground predators could be improved by recording the distance from the observer to the predator whether the predator be seen whilst at a survey point or whilst the observer is travelling from one survey site to another. If kangaroos were also monitored a record of the grazing pressure on the various vegetation communities at Mulligans Flat could be obtained.

Ideally the vegetation changes need to be monitored as a separate exercise to the bird survey and conducted by a person with relevant botanical expertise. Yearly measures of changes in biomass and plant composition, density and height of the different vegetation strata needs to be collected in addition to the yearly photographic records. The habitat complexity assessment needs to be repeated annually with all sites being assessed by the one person.

Acknowledgments
COG would like to thank the Parks and Conservation Service of Environment, ACT, specifically Canberra Nature Park North for allowing COG access and for assistance in setting up the sites. The enthusiasm of Jenny Bounds needs to be acknowledged for without her hard work, dedication and mud cake it is unlikely that the surveys would have occurred and it is unlikely that such a large group of observers would continue to have routinely give up their Sunday mornings. Many thanks to David Purchase and David Freudenberger who acted as referees and made the report readable and to Nicki Taws who produced the map (Figure 1).

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Appendix I. Locations of Canberra Ornithologists Group's Mulligans Flat survey sites.

	Lat:				Long:		
Site	Deg	Mins	Secs		Deg	Mins	Secs
1	35	10	19		149	9	15
2	35	10	9		149	9	13
3	35	10	0		149	9	22
4	35	9	55		149	9	34
5	35	9	57		149	9	50
6	35	9	48		149	9	14
7	35	9	45		149	9	18
8	35	9	54		149	9	9
9	35	9	59		149	8	55
10	35	9	18		149	9	37
11	35	10	17		149	9	22
12	35	10	27		149	9	30
13	35	10	35		149	9	25
14	35	10	46		149	9	28
15	35	10	40		149	9	44
16	35	10	31		149	9	40
17	35	10	32		149	9	38
18	35	10	15		149	9	30
19	35	10	9		149	9	46
20	35	10	7		149	9	53
21	35	9	54		149	10	15
22	35	9	59		149	10	19
23	35	10	11		149	9	54
24	35	10	20		149	9	50

Appendix II. List of contributors and the number of times each surveyed

	Survey number																										
Observers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total
D. Pfanner	1	1	1	1	1			1		1			1	1	1	1			1		1		1	1		1	16
M. Clayton	1	1	1	1	1	1		1		1	1	1		1			1				1	1					14
H. Hahne	1		1	1	1	1			1	1	1	1	1		1				1	1		1	1	1	1	1	18
K. Hahne	1		1	1	1	1	1		1	1	1	1	1		1	1			1	1		1	1	1	1	1	20
P. Fennell	1	1	1			1	1		1	1	1	1				1				1	1	1			1		14
B. Lindenmayer	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	23
J. McDonnell	1	1		1	1	1		1	1			1	1	1				1	1	1	1			1			15
T. Dawkins	1																										1
J. Bounds	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	25
C. Newmann	1		1		1	1	1	1	1	1			1	1			1				1				1		13
J. Avery	1	1	1	1		1	1	1	1			1	1		1	1											12
M. Moffet	1	1		1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1		1					19
M. Butterfield		1																									1
A. Ford		1	1	1	1					1	1	1	1	1	1	1											11
M. Brookfield		1	1	1	1		1	1		1	1	1		1		1	1	1				1					14
R. Bell		1	1	1	1		1	1	1			1															8
M. Doyle			1																1								2
R. Blemings			1																								1
M. Delahoy			1			1																					2
P. Wickstead			1	1		1	1	1		1	1	1	1	1	1			1	1			1	1	1		1	17
G. Duggan				1	1																						2
A. Scott					1			1	1																		3
L. Horodny					1																						1
D. von Behrens					1																						1
N. Taws					1	1	1	1	1	1			1	1		1		1			1		1			1	13
P. Taylor					1																						1
S. Newbery						1			1																		2
A. Rice							1	1																			2
J. Gleeson								1																			1
H. Stevens									1																		1
A. Newbery									1																		1
P. Roberts									1	1	1		1	1	1	1	1	1									9
J. Lipscome										1	1		1		1	1	1	1	1			1	1	1			11
T. Lipscome										1	1		1		1	1	1	1	1				1				9
P. Goddard											1																1
A. Bestlow												1	1							1	1						4
J. Holland												1	1	1	1	1		1	1	1	1	1	1	1	1	1	14
M. Donaghy												1															1
S. Brand															1												1
D. Lindenmayer																	1										1
D. Rosalby																			1								1
J. McGuiness																			1	1	1	1					4
B. Allan																				1							1
C. Buer																						1	1	1	1	1	5
K. Walter																						1					1
A. Smith																									1		1
A. Rowell																									1		1
A. Leavesley																										1	1
S. Ramsey																										1	1
G. Ramsey																										1	1

COG Woodland Bird Survey: Sub-site Habitat Complexity Assessment

Site	Sub-site	Date	Observer

	0	1	2	Score
Tree canopy >6m tall, % cover	<1%	1-10% >40%	11-40%	
Eucalypt regeneration <6m tall, % cover	<1% >50%	1-10% 26-50%	11-25%	
Number of tree species (>6m) (indicate species if known and proportion)	1	2-3	4 or more	
Gross tree health: % of eucalypt canopy (all age classes) with significant leaf damage or loss	>50%	10-50%	<10%	
Tall shrubs/small non-eucalypt trees (2-6m), % cover (indicate species if known)	<1% >50%	1-10% 26-50%	11-25%	
Shrubs 0.5-2m, % cover (indicate species if known)	<1% >50%	1-10% 26-50%	11-25%	
Fill in only if all shrub cover (0.5-6m) >20%: % of shrub cover that is native	0-25%	>25%		
Ground layer (notes on main grass species, level of grazing, bare ground, major weeds)	tall and dense or short and very sparse	short/medium height and density, fairly even	Patchy, tussocky, or with many sub-shrubs, varying height and density	
% of ground layer that is native	<10%	10-50%	>50%	
Log/branch/stump, % cover	<1%	1-10%	>10%	
Rocks, % cover	<1% >25%	1-25%		
No. of tree hollows	0	1-5	>6	
No. of mistletoes	0 >40	1-5 21-40	6-20	
TOTAL				

NOTES: Indicate other relevant features of site, e.g. proximity to water source, cleared land, exotic vegetation, houses, gardens, rubbish tip; isolated woodland patch, erosion, other damage/disturbance etc.

Appendix IV. Species list with common and scientific names of birds recorded during the 1986-1989 and 1995-2000 surveys at Mulligans Flat Nature Reserve, ACT. All names taken from Christidis and Boles, 1994.

RAOU Name	Family	Genus	Species
WOODLAND BIRDS			
Stubble Quail	PHASIANIDAE	Coturnix	novaezelandiae
Brown Quail	PHASIANIDAE	Coturnix	australis
Painted Button-quail	TURNICIDAE	Turnix	varia
Peaceful Dove	COLUMBIDAE	Geopelia	placida
Common Bronzewing	COLUMBIDAE	Phaps	chalcoptera
Brush Bronzewing	COLUMBIDAE	Phaps	elegans
Crested Pigeon	COLUMBIDAE	Ocyphaps	lophotes
Brown Goshawk	ACCIPITRIDAE	Accipiter	fasciatus
Collared Sparrowhawk	ACCIPITRIDAE	Accipiter	cirrhocephalus
Wedge-tailed Eagle	ACCIPITRIDAE	Aquila	audax
Little Eagle	ACCIPITRIDAE	Hieraaetus	morphnoides
Whistling Kite	ACCIPITRIDAE	Haliastur	sphenurus
Black-shouldered Kite	ACCIPITRIDAE	Elanus	notatus
Australian Hobby	FALCONIDAE	Falco	longipennis
Brown Falcon	FALCONIDAE	Falco	berigora
Australian Kestrel	FALCONIDAE	Falco	cenchroides
Southern Boobook	STRIGIDAE	Ninox	novaeseelandiae
Little Lorikeet	LORIIDAE	Glossopsitta	pusilla
Glossy Black-Cockatoo	CACATUIDAE	Calyptorhynchus	lathami
Gang-gang Cockatoo	CACATUIDAE	Callocephalon	fimbriatum
Sulphur-crested Cockatoo	CACATUIDAE	Cacatua	galerita
Little Corella	CACATUIDAE	Cacatua	sanguinea
Galah	CACATUIDAE	Cacatua	roseicapilla
Superb Parrot	POLYTELITIDAE	Polytelis	swainsonii
Australian King-Parrot	POLYTELITIDAE	Alisterus	scapularis
Crimson Rosella	PLATYCERCIDAE	Platycercus	elegans
Eastern Rosella	PLATYCERCIDAE	Platycercus	eximius
Red-rumped Parrot	PLATYCERCIDAE	Psephotus	haematonotus
Tawny Frogmouth	PODARGIDAE	Podargus	strigoides
Australian Owlet-nightjar	AEGOTHELIDAE	Aegotheles	cristatus
Dollarbird	CORACIIDAE	Eurystomus	orientalis
Laughing Kookaburra	ALCEDINIDAE	Dacelo	novaeguineae
Sacred Kingfisher	ALCEDINIDAE	Halcyon	sancta
Rainbow Bee-eater	MEROPIDAE	Merops	ornatus
Pallid Cuckoo	CUCULIDAE	Cuculus	pallidus
Fan-tailed Cuckoo	CUCULIDAE	Cuculus	pyrrhophanus
Brush Cuckoo	CUCULIDAE	Cuculus	variolosus
Horsfield's Bronze-Cuckoo	CUCULIDAE	Chrysococcyx	basalis
Shining Bronze-Cuckoo	CUCULIDAE	Chrysococcyx	lucidus
Welcome Swallow	HIRUNDINIDAE	Hirundo	neoxena
Tree Martin	HIRUNDINIDAE	Cecropis	nigricans
Fairy Martin	HIRUNDINIDAE	Cecropis	ariel
Grey Fantail	MUSCICAPIDAE	Rhipidura	fuliginosa
Willie Wagtail	MUSCICAPIDAE	Rhipidura	leucophrys
Leaden Flycatcher	MUSCICAPIDAE	Myiagra	rubecula

Restless Flycatcher	MUSCICAPIDAE	Myiagra	inquieta
Jacky Winter	MUSCICAPIDAE	Microeca	leucophaea
Scarlet Robin	MUSCICAPIDAE	Petroica	multicolor
Red-capped Robin	MUSCICAPIDAE	Petroica	goodenovii
Flame Robin	MUSCICAPIDAE	Petroica	phoenicea
Hooded Robin	MUSCICAPIDAE	Melanodryas	cucullata
Eastern Yellow Robin	MUSCICAPIDAE	Eopsaltria	australis
Golden Whistler	MUSCICAPIDAE	Pachycephala	pectoralis
Rufous Whistler	MUSCICAPIDAE	Pachycephala	rufiventris
Grey Shrike-thrush	MUSCICAPIDAE	Colluricincla	harmonica
Australian Magpie-lark	GRALLINIDAE	Grallina	cyanoleuca
Crested Shrike-tit	MUSCICAPIDAE	Falcunculus	frontatus
Black-faced Cuckoo-shrike	CAMPEPHAGIDAE	Coracina	novaehollandiae
White-bellied Cuckoo-shrike	CAMPEPHAGIDAE	Coracina	papuensis
White-winged Triller	CAMPEPHAGIDAE	Lalage	sueurii
White-throated Gerygone	ACANTHIZIDAE	Gerygone	olivacea
Western Gerygone	ACANTHIZIDAE	Gerygone	fusca
Weebill	ACANTHIZIDAE	Smicrornis	brevirostris
Southern Whiteface	ACANTHIZIDAE	Aphelocephala	leucopsis
Striated Thornbill	ACANTHIZIDAE	Acanthiza	lineata
Yellow Thornbill	ACANTHIZIDAE	Acanthiza	nana
Brown Thornbill	ACANTHIZIDAE	Acanthiza	pusilla
Buff-rumped Thornbill	ACANTHIZIDAE	Acanthiza	reguloides
Yellow-rumped Thornbill	ACANTHIZIDAE	Acanthiza	chrysorrhoa
Speckled Warbler	ACANTHIZIDAE	Sericornis	sagittatus
Brown Songlark	SYLVIIDAE	Cinclorhamphus	cruralis
Rufous Songlark	SYLVIIDAE	Cinclorhamphus	mathewsi
Superb Fairy-wren	MALURIDAE	Malurus	cyaneus
White-browed Woodswallow	ARTAMIDAE	Artamus	superciliosus
Dusky Woodswallow	ARTAMIDAE	Artamus	cyanopterus
Varied Sittella	NEOSITTIDAE	Daphoenositta	chrysoptera
Brown Treecreeper	CLIMACTERIDAE	Climacteris	picumnus
White-throated Treecreeper	CLIMACTERIDAE	Climacteris	leucophaea
Mistletoebird	DICAEIDAE	Dicaeum	hirundinaceum
Spotted Pardalote	PARDALOTIDAE	Pardalotus	punctatus·
Silvereye	ZOSTEROPIDAE	Zosterops	lateralis
White-naped Honeyeater	MELIPHAGIDAE	Melithreptus	lunatus
Brown-headed Honeyeater	MELIPHAGIDAE	Melithreptus	brevirostris
Eastern Spinebill	MELIPHAGIDAE	Acanthorhynchus	tenuirostris
Regent Honeyeater	MELIPHAGIDAE	Xanthomyza	phrygia
Fuscous Honeyeater	MELIPHAGIDAE	Lichenostomus	fuscus
Yellow-faced Honeyeater	MELIPHAGIDAE	Lichenostomus	chrysops
White-eared Honeyeater	MELIPHAGIDAE	Lichenostomus	leucotis
White-plumed Honeyeater	MELIPHAGIDAE	Lichenostomus	penicillatus
Noisy Miner	MELIPHAGIDAE	Manorina	melanocephala
Red Wattlebird	MELIPHAGIDAE	Anthochaera	carunculata
Noisy Friarbird	MELIPHAGIDAE	Philemon	corniculatus
Little Friarbird	MELIPHAGIDAE	Philemon	citreogularis
Richard's Pipit	MOTACILLIDAE	Anthus	novaeseelandiae
Singing Bushlark	ALAUDIDAE	Mirafra	javanica
Diamond Firetail	PLOCEIDAE	Emblema	guttata
Double-barred Finch	PLOCEIDAE	Poephila	bichenovii
Red-browed Firetail	PLOCEIDAE	Emblema	temporalis
Olive-backed Oriole	ORIOLIDAE	Oriolus	sagittatus

White-winged Chough	CORCORACIDAE	Corcorax	melanorhampho s
Pied Currawong	CRACTICIDAE	Strepera	graculina
Grey Currawong	CRACTICIDAE	Strepera	versicolor
Pied Butcherbird	CRACTICIDAE	Cracticus	nigrogularis
Grey Butcherbird	CRACTICIDAE	Cracticus	torquatus
Australian Magpie	CRACTICIDAE	Gymnorhina	tibicen
Australian Raven	CORVIDAE	Corvus	coronoides
Little Raven	CORVIDAE	Corvus	mellori
Striated Pardalote	PARDALOTIDAE	Pardalotus	striatus
Skylark	ALAUDIDAE	Alauda	arvensis
House Sparrow	PASSERIDAE	Passer	domesticus
European Goldfinch	FRINGILLIDAE	Carduelis	carduelis
Common Myna	STURNIDAE	Acridotheres	tristis
Common Starling	TURNIDAE	Sturnus	vulgaris
WATERBIRDS			
Eurasian Coot	RALLIDAE	Fulica	atra
Australasian Grebe	PODICIPEDIDAE	Tachybaptus	novaehollandiae
Hoary-headed Grebe	PODICIPEDIDAE	Poliocephalus	poliocephalus
Great Cormorant	PHALACROCORACIDAE	Phalacrocorax	carbo
Little Black Cormorant	PHALACROCORACIDAE	Phalacrocorax	sulcirostris
Little Pied Cormorant	PHALACROCORACIDAE	Phalacrocorax	melanoleucos
Darter	ANHINGIDAE	Anhinga	melanogaster
Red-kneed Dotterel	CHARADRIIDAE	Erythrogonys	cinctus
Masked Lapwing	CHARADRIIDAE	Vanellus	miles
Black-fronted Plover	CHARADRIIDAE	Charadrius	melanops
Greenshank	SCOLOPACIDAE	Tringa	nebularia
Sharp-tailed Sandpiper	SCOLOPACIDAE	Calidris	acuminata
Latham's Snipe	SCOLOPACIDAE	Gallinago	hardwickii
Sacred Ibis	PLATALEIDAE	Threskiornis	aethiopica
Straw-necked Ibis	PLATALEIDAE	Threskiornis	spinicollis
Yellow-billed Spoonbill	PLATALEIDAE	Platalea	flavipes
White-faced Heron	ARDEIDAE	Ardea	novaehollandiae
Pacific Heron	ARDEIDAE	Ardea	pacifica
Rufous Night Heron	ARDEIDAE	Nycticorax	caledonicus
Maned Duck	ANATIDAE	Chenonetta	jubata
Black Swan	ANATIDAE	Cygnus	atratus
Australian Shelduck	ANATIDAE	Tadorna	tadornoides
Pacific Black Duck	ANATIDAE	Anas	superciliosa
Grey Teal	ANATIDAE	Anas	gibberifrons
Australasian Shoveler	ANATIDAE	Anas	rhynchotis
Hardhead	ANATIDAE	Aythya	australis
Musk Duck	ANATIDAE	Biziura	lobata

Appendix V. Prevalence (number of surveys species recorded within plots, (max. 26)) of bird species at Mulligans Flat Nature Reserve, ACT.
Listed in order of overall prevalence.

Habitat	Grass				Ridge woodland							Open woodland								Mixed grsss/shrub							Dam			
Site number	9	16	24	mean	5	7	8	10	12	19	mean	1	3	6	11	13	15	17	mean	4	18	20	21	22	23	mean	2	14	mean	mean
Common name																														
Buff-rumped Thornbill	2	4	7	**4.33**	12	10	3	12	10	10	**9.50**	5	10	10	10	5	0	10	**7.14**	9	13	22	15	12	19	**15.00**	6	0	**3.00**	**9.00**
Crimson Rosella	10	8	8	**8.67**	4	9	4	5	7	6	**5.83**	11	5	7	11	15	16	13	**11.14**	3	15	9	6	5	14	**8.67**	7	12	**9.50**	**8.75**
Striated Pardalote	2	2	2	**2.00**	7	2	3	7	12	6	**6.17**	13	3	3	13	10	8	12	**8.86**	3	9	12	3	3	15	**7.50**	5	11	**8.00**	**6.92**
Grey Fantail	2	3	3	**2.67**	9	6	4	3	6	5	**5.50**	14	15	14	7	8	3	15	**10.86**	5	7	9	4	4	4	**5.50**	10	0	**5.00**	**6.67**
Australian Magpie	7	5	9	**7.00**	5	4	4	1	7	5	**4.33**	9	7	3	10	10	13	3	**7.86**	8	8	2	3	6	5	**5.33**	7	11	**9.00**	**6.33**
White-throated Treecreeper	0	2	1	**1.00**	10	10	3	6	12	4	**7.50**	7	6	12	15	6	0	10	**8.00**	3	11	2	1	0	6	**3.83**	3	2	**2.50**	**5.50**
Striated Thornbill	0	4	4	**2.67**	6	4	1	15	2	9	**6.17**	4	4	8	3	3	0	7	**4.14**	1	10	13	6	4	10	**7.33**	2	0	**1.00**	**5.00**
Rufous Whistler	0	2	0	**0.67**	2	8	2	2	9	0	**3.83**	11	8	6	15	12	2	9	**9.00**	6	3	3	3	4	4	**3.83**	4	1	**2.50**	**4.83**
Weebill	1	11	11	**7.67**	1	1	1	3	2	0	**1.33**	5	8	1	6	8	5	2	**5.00**	3	2	14	5	12	6	**7.00**	3	2	**2.50**	**4.71**
Scarlet Robin	1	2	2	**1.67**	5	7	1	8	11	3	**5.83**	1	5	8	7	7	0	7	**5.00**	3	6	5	7	3	3	**4.50**	5	0	**2.50**	**4.46**
Noisy Friarbird	9	4	8	**7.00**	6	2	3	2	1	4	**3.00**	9	6	3	7	6	3	4	**5.43**	7	4	0	3	2	4	**3.33**	8	2	**5.00**	**4.46**
Spotted Pardalote	0	2	0	**0.67**	5	1	2	5	6	6	**4.17**	6	4	3	5	8	4	9	**5.57**	4	6	8	3	1	7	**4.83**	1	4	**2.50**	**4.17**
Eastern Rosella	6	8	3	**5.67**	2	2	1	1	1	1	**1.33**	3	2	1	1	6	14	1	**4.00**	0	1	1	1	3	4	**1.67**	6	21	**13.50**	**3.75**
Black-faced Cuckoo-shrike	3	5	6	**4.67**	0	2	1	3	3	4	**2.17**	4	6	1	3	10	1	8	**4.71**	6	4	3	4	2	2	**3.50**	3	5	**4.00**	**3.71**
White-throated Gerygone	0	1	1	**0.67**	1	5	1	2	0	0	**1.50**	9	7	10	7	10	3	8	**7.71**	4	5	0	0	0	0	**1.50**	6	4	**5.00**	**3.50**
Sulphur-crested Cockatoo	1	2	3	**2.00**	0	5	3	0	4	1	**2.17**	8	3	5	4	8	3	2	**4.71**	2	3	2	0	1	1	**1.50**	3	16	**9.50**	**3.33**
Galah	6	1	3	**3.33**	2	1	0	0	1	0	**0.67**	3	4	1	6	4	9	2	**4.14**	1	1	0	1	2	1	**1.00**	6	16	**11.00**	**2.96**
Yellow-rumped Thornbill	1	8	7	**5.33**	2	1	0	2	1	0	**1.00**	1	3	3	3	1	0	0	**1.57**	7	1	6	6	11	2	**5.50**	4	0	**2.00**	**2.92**
Noisy Miner	5	5	1	**3.67**	0	2	0	0	0	0	**0.33**	0	0	0	0	7	24	0	**4.43**	0	0	0	0	0	0	**0.00**	0	18	**9.00**	**2.58**
White-winged Chough	0	1	0	**0.33**	2	1	4	3	2	4	**2.67**	7	1	3	12	5	2	2	**4.57**	4	2	0	0	0	2	**1.33**	1	0	**0.50**	**2.42**
Brown Thornbill	0	1	0	**0.33**	4	1	1	2	1	6	**2.50**	2	3	3	2	1	0	2	**1.86**	6	1	5	1	1	4	**3.00**	2	0	**1.00**	**2.04**
Western Gerygone	2	3	3	**2.67**	0	8	1	0	0	0	**1.50**	2	6	5	4	3	1	3	**3.43**	2	0	0	0	3	0	**0.83**	0	0	**0.00**	**1.92**
Yellow-faced Honeyeater	0	0	0	**0.00**	1	3	0	2	1	1	**1.33**	5	6	1	3	0	0	0	**2.14**	4	2	4	2	4	5	**3.50**	1	0	**0.50**	**1.88**
Australian Raven	2	1	1	**1.33**	2	2	1	0	3	0	**1.33**	4	2	2	1	4	3	0	**2.29**	0	3	0	2	0	0	**0.83**	2	9	**5.50**	**1.83**
Australian Magpie-lark	2	0	0	**0.67**	0	1	0	1	0	0	**0.33**	0	1	1	0	3	4	0	**1.29**	0	0	0	0	0	0	**0.00**	10	18	**14.00**	**1.71**
Leaden Flycatcher	0	2	1	**1.00**	1	4	0	0	0	1	**1.00**	6	4	3	3	0	0	5	**3.00**	2	1	0	0	0	3	**1.00**	2	1	**1.50**	**1.63**
Olive-backed Oriole	0	2	0	**0.67**	1	0	1	1	2	2	**1.17**	3	1	0	2	5	4	3	**2.57**	3	3	0	0	0	1	**1.17**	2	3	**2.50**	**1.63**
Grey Shrike-thrush	0	0	1	**0.33**	1	1	0	1	4	0	**1.17**	3	3	0	4	5	1	3	**2.71**	2	1	1	1	0	2	**1.17**	3	1	**2.00**	**1.58**
Superb Fairy-wren	0	0	0	**0.00**	0	0	0	0	0	2	**0.33**	2	2	0	0	0	0	1	**0.71**	0	2	5	5	6	3	**3.50**	10	0	**5.00**	**1.58**
Laughing Kookaburra	0	0	2	**0.67**	2	1	0	0	3	2	**1.33**	3	5	1	4	1	5	2	**3.00**	2	2	0	0	0	0	**0.67**	0	2	**1.00**	**1.54**
Willie Wagtail	2	1	0	**1.00**	0	0	0	0	1	0	**0.17**	2	0	0	0	1	5	0	**1.14**	0	0	0	0	0	0	**0.00**	5	18	**11.50**	**1.46**
Brown-headed Honeyeater	0	1	1	**0.67**	1	1	0	0	0	1	**0.50**	3	3	1	1	1	1	2	**1.71**	1	2	1	3	4	2	**2.17**	1	0	**0.50**	**1.29**
Grey Currawong	0	0	0	**0.00**	1	1	0	5	3	1	**1.83**	3	1	1	0	0	2	1	**1.14**	3	0	1	1	1	0	**1.00**	1	1	**1.00**	**1.13**
Red Wattlebird	1	3	2	**2.00**	2	0	0	3	0	1	**1.00**	0	2	0	0	0	3	1	**0.86**	1	0	1	0	1	0	**0.50**	3	2	**2.50**	**1.08**

Habitat	Grass				Ridge woodland							Open woodland								Mixed grsss/shrub							Dam			
Site number	9	16	24	mean	5	7	8	10	12	19	mean	1	3	6	11	13	15	17	mean	4	18	20	21	22	23	mean	2	14	mean	mean
Common name																														
Golden Whistler	0	0	0	**0.00**	1	1	1	1	1	2	**1.17**	0	0	0	2	3	0	2	**1.00**	0	2	4	0	0	3	**1.50**	1	1	**1.00**	**1.04**
Common Starling	2	0	2	**1.33**	0	0	0	0	0	0	**0.00**	2	0	0	1	0	1	0	**0.57**	0	0	0	0	1	0	**0.17**	3	13	**8.00**	**1.04**
Yellow Thornbill	0	0	0	**0.00**	2	1	0	0	0	0	**0.50**	0	2	0	0	1	0	0	**0.43**	7	2	1	3	4	0	**2.83**	1	0	**0.50**	**1.00**
Pallid Cuckoo	2	4	0	**2.00**	1	2	0	0	1	0	**0.67**	2	2	2	1	2	1	2	**1.71**	0	0	0	0	0	0	**0.00**	1	1	**1.00**	**1.00**
Mistletoebird	0	0	3	**1.00**	3	0	0	1	0	0	**0.67**	1	0	3	1	1	0	0	**0.86**	1	0	3	2	1	2	**1.50**	0	0	**0.00**	**0.92**
Eastern Spinebill	0	0	1	**0.33**	1	0	0	1	0	1	**0.50**	0	1	0	0	0	0	1	**0.29**	0	0	6	4	1	4	**2.50**	0	0	**0.00**	**0.88**
Speckled Warbler	0	1	0	**0.33**	0	1	0	2	0	0	**0.50**	0	0	1	1	0	0	0	**0.29**	1	0	1	3	5	2	**2.00**	3	0	**1.50**	**0.88**
Grey Butcherbird	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	0	0	0	9	5	1	**2.14**	0	1	0	0	0	0	**0.17**	0	5	**2.50**	**0.88**
Silvereye	0	2	0	**0.67**	0	0	1	0	0	1	**0.33**	2	0	0	1	1	1	0	**0.71**	0	0	3	2	2	1	**1.33**	1	0	**0.50**	**0.75**
Pied Currawong	1	0	0	**0.33**	1	1	1	0	0	1	**0.67**	0	0	0	3	0	0	1	**0.57**	1	0	0	0	4	3	**1.33**	0	0	**0.00**	**0.71**
White-winged Triller	0	0	0	**0.00**	0	0	0	0	0	1	**0.17**	4	0	0	0	3	1	2	**1.43**	0	0	0	0	0	0	**0.00**	2	4	**3.00**	**0.71**
Sacred Kingfisher	0	0	1	**0.33**	1	0	0	0	0	1	**0.33**	2	3	1	1	0	0	1	**1.14**	0	1	0	0	0	2	**0.50**	2	0	**1.00**	**0.67**
Shining Bronze-Cuckoo	0	0	1	**0.33**	1	1	0	0	0	0	**0.33**	1	1	2	1	1	1	2	**1.29**	0	0	0	0	0	0	**0.00**	1	0	**0.50**	**0.54**
Varied Sittella	0	1	0	**0.33**	0	0	1	3	0	0	**0.67**	0	1	2	1	0	0	1	**0.71**	0	1	0	0	0	1	**0.33**	0	0	**0.00**	**0.50**
Dusky Woodswallow	0	0	1	**0.33**	0	0	0	0	0	0	**0.00**	1	0	0	0	0	0	0	**0.14**	0	0	0	0	0	0	**0.00**	0	9	**4.50**	**0.46**
White-plumed Honeyeater	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	2	1	0	0	2	0	1	**0.86**	0	0	0	0	1	0	**0.17**	1	2	**1.50**	**0.42**
Welcome Swallow	1	3	0	**1.33**	0	0	0	0	0	0	**0.00**	0	0	0	0	0	0	0	**0.00**	0	0	0	1	0	0	**0.17**	1	4	**2.50**	**0.42**
Hooded Robin	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	1	0	0	1	0	0	0	**0.29**	0	0	0	4	2	1	**1.17**	0	0	**0.00**	**0.38**
Horsfield's Bronze-Cuckoo	0	0	0	**0.00**	1	1	0	1	0	0	**0.50**	0	1	0	0	1	2	0	**0.57**	0	0	0	0	0	0	**0.00**	1	1	**1.00**	**0.38**
White-naped Honeyeater	1	0	0	**0.33**	0	1	0	1	1	1	**0.67**	0	0	0	0	0	0	1	**0.14**	0	1	0	0	0	0	**0.17**	0	0	**0.00**	**0.29**
Restless Flycatcher	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	0	0	0	1	0	0	**0.14**	0	0	0	0	0	0	**0.00**	1	5	**3.00**	**0.29**
Brush Cuckoo	0	0	0	**0.00**	0	0	0	1	0	1	**0.33**	0	0	0	2	0	0	0	**0.29**	2	0	0	0	0	0	**0.33**	0	0	**0.00**	**0.25**
Rufous Songlark	1	0	0	**0.33**	0	0	0	0	0	0	**0.00**	2	0	0	0	0	0	0	**0.29**	0	0	0	0	0	0	**0.00**	1	2	**1.50**	**0.25**
Red-rumped Parrot	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	0	0	0	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	6	**3.00**	**0.25**
Common Bronzewing	0	0	0	**0.00**	0	0	0	1	0	0	**0.17**	0	0	0	0	1	0	0	**0.14**	0	1	0	0	0	0	**0.17**	1	1	**1.00**	**0.21**
Brown Treecreeper	0	0	0	**0.00**	0	0	1	0	0	0	**0.17**	0	0	0	0	2	0	0	**0.29**	0	0	0	0	0	0	**0.00**	0	2	**1.00**	**0.21**
Dollarbird	0	0	0	**0.00**	1	0	0	0	0	0	**0.17**	1	0	0	0	0	0	0	**0.14**	0	0	0	0	0	0	**0.00**	0	3	**1.50**	**0.21**
Crested Pigeon	1	0	0	**0.33**	0	0	0	0	0	0	**0.00**	0	0	0	0	0	3	0	**0.43**	0	0	0	0	0	0	**0.00**	0	0	**0.00**	**0.17**
Fan-tailed Cuckoo	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	1	1	0	0	0	0	**0.29**	0	2	0	0	0	0	**0.33**	0	0	**0.00**	**0.17**
White-eared Honeyeater	0	0	0	**0.00**	0	0	0	0	1	0	**0.17**	0	0	0	1	0	0	1	**0.29**	0	1	0	0	0	0	**0.17**	0	0	**0.00**	**0.17**
Painted Button-quail	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	0	0	0	0	0	0	**0.00**	0	1	0	1	1	0	**0.50**	0	0	**0.00**	**0.13**
Brown Goshawk	0	0	0	**0.00**	1	1	0	0	0	0	**0.33**	0	0	0	1	0	0	0	**0.14**	0	0	0	0	0	0	**0.00**	0	0	**0.00**	**0.13**
Eastern Yellow Robin	0	0	0	**0.00**	1	0	0	0	2	0	**0.50**	0	0	0	0	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	0	0	**0.00**	**0.13**
Crested Shrike-tit	0	0	0	**0.00**	0	0	0	0	0	0	**0.00**	1	0	0	0	0	0	1	**0.29**	0	0	0	1	0	0	**0.17**	0	0	**0.00**	**0.13**

Habitat	Grass				Ridge woodland							Open woodland								Mixed grsss/shrub							Dam			
Site number	9	16	24	mean	5	7	8	10	12	19	mean	1	3	6	11	13	15	17	mean	4	18	20	21	22	23	mean	2	14	mean	mean
Common name																														
Little Friarbird	0	0	0	0.00	0	0	0	0	0	0	0.00	1	0	0	0	0	0	0	0.14	0	0	0	0	0	0	0.00	1	1	1.00	0.13
Double-barred Finch	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	1	0	0	0	0.17	2	0	1.00	0.13
Australian Kestrel	0	0	0	0.00	0	0	0	0	0	0	0.00	1	0	0	0	0	1	0	0.29	0	0	0	0	0	0	0.00	0	0	0.00	0.08
Fuscous Honeyeater	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	1	0	0	1	0.33	0	0	0.00	0.08
Whistling Kite	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	2	1.00	0.08
Common Myna	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	2	1.00	0.08
Wedge-tailed Eagle	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	1	0	0	0	0	0	0.17	0	0	0.00	0.04
Gang-gang Cockatoo	0	0	0	0.00	0	0	0	0	0	1	0.17	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.04
Superb Parrot	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	1	0	0	0.14	0	0	0	0	0	0	0.00	0	0	0.00	0.04
Jacky Winter	0	1	0	0.33	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.04
Red-capped Robin	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	1	0	0.17	0	0	0.00	0.04
Diamond Firetail	0	0	0	0.00	0	0	0	0	0	0	0.00	0	1	0	0	0	0	0	0.14	0	0	0	0	0	0	0.00	0	0	0.00	0.04
Little Raven	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	1	0	0.14	0	0	0	0	0	0	0.00	0	0	0.00	0.04
Collared Sparrowhawk	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	1	0	0.50	0.04
Black-shouldered Kite	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	1	0.50	0.04
Tree Martin	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	1	0.50	0.04
Stubble Quail	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Brown Quail	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Peaceful Dove	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Little Eagle	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Australian Hobby	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Brown Falcon	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Southern Boobook	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Little Lorikeet	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Glossy Black-Cockatoo	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Little Corella	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Australian King-Parrot	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Australian Owlet-nightjar	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Rainbow Bee-eater	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Flame Robin	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
White-bellied Cuckoo-shrike	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Southern Whiteface	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
White-browed Woodswallow	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Richard's Pipit	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
Pied Butcherbird	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00
European Goldfinch	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0.00	0	0	0.00	0.00

Appendix VI. Prevalence (number of surveys species recorded in within plots (max. 26)) of bird species at Mulligans Flat Nature Reserve, ACT. Listed in order of prevalence within habitats.

Habitat	Grass				Ridge woodland							Open woodland							
Site number	16	9	24	mean	5	7	8	10	12	19	mean	1	3	6	11	13	15	17	mean
Common name					Common name							Common name							
Crimson Rosella	8	10	8	**8.7**	Buff-rumped Thornbill	12	10	3	12	10	10	**9.5**	Crimson Rosella	11	5	7	11	15	16	13	**11.1**
Weebill	11	1	11	**7.7**	White-throated Treecreeper	10	10	3	6	12	4	**7.5**	Grey Fantail	14	15	14	7	8	3	15	**10.9**
Noisy Friarbird	4	9	8	**7.0**	Striated Thornbill	6	4	1	15	2	9	**6.2**	Rufous Whistler	11	8	6	15	12	2	9	**9.0**
Australian Magpie	5	7	9	**7.0**	Striated Pardalote	7	2	3	7	12	6	**6.2**	Striated Pardalote	13	3	3	13	10	8	12	**8.9**
Eastern Rosella	8	6	3	**5.7**	Crimson Rosella	4	9	4	5	7	6	**5.8**	White-throated Treecreeper	7	6	12	15	6	0	10	**8.0**
Yellow-rumped Thornbill	8	1	7	**5.3**	Scarlet Robin	5	7	1	8	11	3	**5.8**	Australian Magpie	9	7	3	10	10	13	3	**7.9**
Black-faced Cuckoo-shrike	5	3	6	**4.7**	Grey Fantail	9	6	4	3	6	5	**5.5**	White-throated Gerygone	9	7	10	7	10	3	8	**7.7**
Buff-rumped Thornbill	4	2	7	**4.3**	Australian Magpie	5	4	4	1	7	5	**4.3**	Buff-rumped Thornbill	5	10	10	10	5	0	10	**7.1**
Noisy Miner	5	5	1	**3.7**	Spotted Pardalote	5	1	2	5	6	6	**4.2**	Spotted Pardalote	6	4	3	5	8	4	9	**5.6**
Galah	1	6	3	**3.3**	Rufous Whistler	2	8	2	2	9	0	**3.8**	Noisy Friarbird	9	6	3	7	6	3	4	**5.4**
Grey Fantail	3	2	3	**2.7**	Noisy Friarbird	6	2	3	2	1	4	**3.0**	Scarlet Robin	1	5	8	7	7	0	7	**5.0**
Western Gerygone	3	2	3	**2.7**	White-winged Chough	2	1	4	3	2	4	**2.7**	Weebill	5	8	1	6	8	5	2	**5.0**
Striated Thornbill	4	0	4	**2.7**	Brown Thornbill	4	1	1	2	1	6	**2.5**	Sulphur-crested Cockatoo	8	3	5	4	8	3	2	**4.7**
Sulphur-crested Cockatoo	2	1	3	**2.0**	Sulphur-crested Cockatoo	0	5	3	0	4	1	**2.2**	Black-faced Cuckoo-shrike	4	6	1	3	10	1	8	**4.7**
Pallid Cuckoo	4	2	0	**2.0**	Black-faced Cuckoo-shrike	0	2	1	3	3	4	**2.2**	White-winged Chough	7	1	3	12	5	2	2	**4.6**
Red Wattlebird	3	1	2	**2.0**	Grey Currawong	1	1	0	5	3	1	**1.8**	Noisy Miner	0	0	0	0	7	24	0	**4.4**
Striated Pardalote	2	2	2	**2.0**	White-throated Gerygone	1	5	1	2	0	0	**1.5**	Galah	3	4	1	6	4	9	2	**4.1**
Scarlet Robin	2	1	2	**1.7**	Western Gerygone	0	8	1	0	0	0	**1.5**	Striated Thornbill	4	4	8	3	3	0	7	**4.1**
Welcome Swallow	3	1	0	**1.3**	Eastern Rosella	2	2	1	1	1	1	**1.3**	Eastern Rosella	3	2	1	1	6	14	1	**4.0**
Australian Raven	1	2	1	**1.3**	Laughing Kookaburra	2	1	0	0	3	2	**1.3**	Western Gerygone	2	6	5	4	3	1	3	**3.4**
Common Starling	0	2	2	**1.3**	Weebill	1	1	1	3	2	0	**1.3**	Laughing Kookaburra	3	5	1	4	1	5	2	**3.0**
Willie Wagtail	1	2	0	**1.0**	Yellow-faced Honeyeater	1	3	0	2	1	1	**1.3**	Leaden Flycatcher	6	4	3	3	0	0	5	**3.0**
Leaden Flycatcher	2	0	1	**1.0**	Australian Raven	2	2	1	0	3	0	**1.3**	Grey Shrike-thrush	3	3	0	4	5	1	3	**2.7**
White-throated Treecreeper	2	0	1	**1.0**	Golden Whistler	1	1	1	1	1	2	**1.2**	Olive-backed Oriole	3	1	0	2	5	4	3	**2.6**
Mistletoebird	0	0	3	**1.0**	Grey Shrike-thrush	1	1	0	1	4	0	**1.2**	Australian Raven	4	2	2	1	4	3	0	**2.3**
Laughing Kookaburra	0	0	2	**0.7**	Olive-backed Oriole	1	0	1	1	2	2	**1.2**	Yellow-faced Honeyeater	5	6	1	3	0	0	0	**2.1**
Rufous Whistler	2	0	0	**0.7**	Leaden Flycatcher	1	4	0	0	0	1	**1.0**	Grey Butcherbird	0	0	0	0	9	5	1	**2.1**
Australian Magpie-lark	0	2	0	**0.7**	Yellow-rumped Thornbill	2	1	0	2	1	0	**1.0**	Brown Thornbill	2	3	3	2	1	0	2	**1.9**
White-throated Gerygone	1	0	1	**0.7**	Red Wattlebird	2	0	0	3	0	1	**1.0**	Pallid Cuckoo	2	2	2	1	2	1	2	**1.7**
Spotted Pardalote	2	0	0	**0.7**	Galah	2	1	0	0	1	0	**0.7**	Brown-headed Honeyeater	3	3	1	1	1	1	2	**1.7**
Silvereye	2	0	0	**0.7**	Pallid Cuckoo	1	2	0	0	1	0	**0.7**	Yellow-rumped Thornbill	1	3	3	3	1	0	0	**1.6**
Brown-headed Honeyeater	1	0	1	**0.7**	Varied Sittella	0	0	1	3	0	0	**0.7**	White-winged Triller	4	0	0	0	3	1	2	**1.4**

Appendix VI cont.

Habitat	Grass				Ridge woodland							Open woodland							
Site number	16	9	24	mean	5	7	8	10	12	19	mean	1	3	6	11	13	15	17	mean
Common name					Common name							Common name							
Olive-backed Oriole	2	0	0	**0.7**	Mistletoebird	3	0	0	1	0	0	**0.7**	Shining Bronze-Cuckoo	1	1	2	1	1	1	2	**1.3**
Crested Pigeon	0	1	0	**0.3**	White-naped Honeyeater	0	1	0	1	1	1	**0.7**	Australian Magpie-lark	0	1	1	0	3	4	0	**1.3**
Sacred Kingfisher	0	0	1	**0.3**	Pied Currawong	1	1	1	0	0	1	**0.7**	Sacred Kingfisher	2	3	1	1	0	0	1	**1.1**
Shining Bronze-Cuckoo	0	0	1	**0.3**	Horsfield's Bronze-Cuckoo	1	1	0	1	0	0	**0.5**	Willie Wagtail	2	0	0	0	1	5	0	**1.1**
Jacky Winter	1	0	0	**0.3**	Eastern Yellow Robin	1	0	0	0	2	0	**0.5**	Grey Currawong	3	1	1	0	0	2	1	**1.1**
Grey Shrike-thrush	0	0	1	**0.3**	Yellow Thornbill	2	1	0	0	0	0	**0.5**	Golden Whistler	0	0	0	2	3	0	2	**1.0**
Brown Thornbill	1	0	0	**0.3**	Speckled Warbler	0	1	0	2	0	0	**0.5**	Mistletoebird	1	0	3	1	1	0	0	**0.9**
Speckled Warbler	1	0	0	**0.3**	Brown-headed Honeyeater	1	1	0	0	0	1	**0.5**	White-plumed Honeyeater	2	1	0	0	2	0	1	**0.9**
Rufous Songlark	0	1	0	**0.3**	Eastern Spinebill	1	0	0	1	0	1	**0.5**	Red Wattlebird	0	2	0	0	0	3	1	**0.9**
Dusky Woodswallow	0	0	1	**0.3**	Brown Goshawk	1	1	0	0	0	0	**0.3**	Superb Fairy-wren	2	2	0	0	0	0	1	**0.7**
Varied Sittella	1	0	0	**0.3**	Sacred Kingfisher	1	0	0	0	0	1	**0.3**	Varied Sittella	0	1	2	1	0	0	1	**0.7**
White-naped Honeyeater	0	1	0	**0.3**	Brush Cuckoo	0	0	0	1	0	1	**0.3**	Silvereye	2	0	0	1	1	1	0	**0.7**
Eastern Spinebill	0	0	1	**0.3**	Shining Bronze-Cuckoo	1	1	0	0	0	0	**0.3**	Horsfield's Bronze-Cuckoo	0	1	0	0	1	2	0	**0.6**
White-winged Chough	1	0	0	**0.3**	Australian Magpie-lark	0	1	0	1	0	0	**0.3**	Pied Currawong	0	0	0	3	0	0	1	**0.6**
Pied Currawong	0	1	0	**0.3**	Superb Fairy-wren	0	0	0	0	0	2	**0.3**	Common Starling	2	0	0	1	0	1	0	**0.6**
					Silvereye	0	0	1	0	0	1	**0.3**	Crested Pigeon	0	0	0	0	0	3	0	**0.4**
					Noisy Miner	0	2	0	0	0	0	**0.3**	Yellow Thornbill	0	2	0	0	1	0	0	**0.4**
					Common Bronzewing	0	0	0	1	0	0	**0.2**	Australian Kestrel	1	0	0	0	0	1	0	**0.3**
					Gang-gang Cockatoo	0	0	0	0	0	1	**0.2**	Fan-tailed Cuckoo	0	1	1	0	0	0	0	**0.3**
					Dollarbird	1	0	0	0	0	0	**0.2**	Brush Cuckoo	0	0	0	2	0	0	0	**0.3**
					Willie Wagtail	0	0	0	0	1	0	**0.2**	Hooded Robin	1	0	0	1	0	0	0	**0.3**
					White-winged Triller	0	0	0	0	0	1	**0.2**	Crested Shrike-tit	1	0	0	0	0	0	1	**0.3**
					Brown Treecreeper	0	0	1	0	0	0	**0.2**	Speckled Warbler	0	0	1	1	0	0	0	**0.3**
					White-eared Honeyeater	0	0	0	0	1	0	**0.2**	Rufous Songlark	2	0	0	0	0	0	0	**0.3**
													Brown Treecreeper	0	0	0	0	2	0	0	**0.3**
													Eastern Spinebill	0	1	0	0	0	0	1	**0.3**
													White-eared Honeyeater	0	0	0	1	0	0	1	**0.3**
													Common Bronzewing	0	0	0	0	1	0	0	**0.1**
													Brown Goshawk	0	0	0	1	0	0	0	**0.1**
													Superb Parrot	0	0	0	0	1	0	0	**0.1**
													Dollarbird	1	0	0	0	0	0	0	**0.1**
													Restless Flycatcher	0	0	0	0	1	0	0	**0.1**
													Dusky Woodswallow	1	0	0	0	0	0	0	**0.1**
													White-naped Honeyeater	0	0	0	0	0	0	1	**0.1**
													Little Friarbird	1	0	0	0	0	0	0	**0.1**
													Diamond Firetail	0	1	0	0	0	0	0	**0.1**
													Little Raven	0	0	0	0	0	1	0	**0.1**

Appendix VI cont.

Habitat	Mixed grass/shrub						
Site number	4	18	20	21	22	23	mean
Common name							
Buff-rumped Thornbill	9	13	22	15	12	19	**15.0**
Crimson Rosella	3	15	9	6	5	14	**8.7**
Striated Pardalote	3	9	12	3	3	15	**7.5**
Striated Thornbill	1	10	13	6	4	10	**7.3**
Weebill	3	2	14	5	12	6	**7.0**
Grey Fantail	5	7	9	4	4	4	**5.5**
Yellow-rumped Thornbill	7	1	6	6	11	2	**5.5**
Australian Magpie	8	8	2	3	6	5	**5.3**
Spotted Pardalote	4	6	8	3	1	7	**4.8**
Scarlet Robin	3	6	5	7	3	3	**4.5**
Rufous Whistler	6	3	3	3	4	4	**3.8**
White-throated Treecreeper	3	11	2	1	0	6	**3.8**
Black-faced Cuckoo-shrike	6	4	3	4	2	2	**3.5**
Superb Fairy-wren	0	2	5	5	6	3	**3.5**
Yellow-faced Honeyeater	4	2	4	2	4	5	**3.5**
Noisy Friarbird	7	4	0	3	2	4	**3.3**
Brown Thornbill	6	1	5	1	1	4	**3.0**
Yellow Thornbill	7	2	1	3	4	0	**2.8**
Eastern Spinebill	0	0	6	4	1	4	**2.5**
Brown-headed Honeyeater	1	2	1	3	4	2	**2.2**
Speckled Warbler	1	0	1	3	5	2	**2.0**
Eastern Rosella	0	1	1	1	3	4	**1.7**
Sulphur-crested Cockatoo	2	3	2	0	1	1	**1.5**
Golden Whistler	0	2	4	0	0	3	**1.5**
White-throated Gerygone	4	5	0	0	0	0	**1.5**
Mistletoebird	1	0	3	2	1	2	**1.5**
Silvereye	0	0	3	2	2	1	**1.3**
White-winged Chough	4	2	0	0	0	2	**1.3**
Pied Currawong	1	0	0	0	4	3	**1.3**
Hooded Robin	0	0	0	4	2	1	**1.2**
Grey Shrike-thrush	2	1	1	1	0	2	**1.2**
Olive-backed Oriole	3	3	0	0	0	1	**1.2**

	Dam		
	14	2	mean
Common name			
Australian Magpie-lark	18	10	**14.0**
Eastern Rosella	21	6	**13.5**
Willie Wagtail	18	5	**11.5**
Galah	16	6	**11.0**
Sulphur-crested Cockatoo	16	3	**9.5**
Crimson Rosella	12	7	**9.5**
Noisy Miner	18	0	**9.0**
Australian Magpie	11	7	**9.0**
Striated Pardalote	11	5	**8.0**
Common Starling	13	3	**8.0**
Australian Raven	9	2	**5.5**
Grey Fantail	0	10	**5.0**
White-throated Gerygone	4	6	**5.0**
Superb Fairy-wren	0	10	**5.0**
Noisy Friarbird	2	8	**5.0**
Dusky Woodswallow	9	0	**4.5**
Black-faced Cuckoo-shrike	5	3	**4.0**
Red-rumped Parrot	6	0	**3.0**
Restless Flycatcher	5	1	**3.0**
White-winged Triller	4	2	**3.0**
Buff-rumped Thornbill	0	6	**3.0**
Welcome Swallow	4	1	**2.5**
Scarlet Robin	0	5	**2.5**
Rufous Whistler	1	4	**2.5**
Weebill	2	3	**2.5**
White-throated Treecreeper	2	3	**2.5**
Spotted Pardalote	4	1	**2.5**
Red Wattlebird	2	3	**2.5**
Olive-backed Oriole	3	2	**2.5**
Grey Butcherbird	5	0	**2.5**
Grey Shrike-thrush	1	3	**2.0**
Yellow-rumped Thornbill	0	4	**2.0**

Appendix VI cont.

Habitat	Mixed grass/shrub						
Site number	4	18	20	21	22	23	mean
Common name							
Galah	1	1	0	1	2	1	**1.0**
Leaden Flycatcher	2	1	0	0	0	3	**1.0**
Grey Currawong	3	0	1	1	1	0	**1.0**
Western Gerygone	2	0	0	0	3	0	**0.8**
Australian Raven	0	3	0	2	0	0	**0.8**
Laughing Kookaburra	2	2	0	0	0	0	**0.7**
Painted Button-quail	0	1	0	1	1	0	**0.5**
Sacred Kingfisher	0	1	0	0	0	2	**0.5**
Red Wattlebird	1	0	1	0	1	0	**0.5**
Fan-tailed Cuckoo	0	2	0	0	0	0	**0.3**
Brush Cuckoo	2	0	0	0	0	0	**0.3**
Varied Sittella	0	1	0	0	0	1	**0.3**
Fuscous Honeyeater	0	0	1	0	0	1	**0.3**
Common Bronzewing	0	1	0	0	0	0	**0.2**
Wedge-tailed Eagle	1	0	0	0	0	0	**0.2**
Welcome Swallow	0	0	0	1	0	0	**0.2**
Red-capped Robin	0	0	0	0	1	0	**0.2**
Crested Shrike-tit	0	0	0	1	0	0	**0.2**
White-naped Honeyeater	0	1	0	0	0	0	**0.2**
White-eared Honeyeater	0	1	0	0	0	0	**0.2**
White-plumed Honeyeater	0	0	0	0	1	0	**0.2**
Double-barred Finch	0	0	1	0	0	0	**0.2**
Grey Butcherbird	0	1	0	0	0	0	**0.2**
Common Starling	0	0	0	0	1	0	**0.2**

	Dam		
	14	2	mean
Common name			
Dollarbird	3	0	**1.5**
Leaden Flycatcher	1	2	**1.5**
Speckled Warbler	0	3	**1.5**
Rufous Songlark	2	1	**1.5**
White-plumed Honeyeater	2	1	**1.5**
Common Bronzewing	1	1	**1.0**
Whistling Kite	2	0	**1.0**
Laughing Kookaburra	2	0	**1.0**
Sacred Kingfisher	0	2	**1.0**
Pallid Cuckoo	1	1	**1.0**
Horsfield's Bronze-Cuckoo	1	1	**1.0**
Golden Whistler	1	1	**1.0**
Striated Thornbill	0	2	**1.0**
Brown Thornbill	0	2	**1.0**
Brown Treecreeper	2	0	**1.0**
Little Friarbird	1	1	**1.0**
Double-barred Finch	0	2	**1.0**
Grey Currawong	1	1	**1.0**
Common Myna	2	0	**1.0**
Collared Sparrowhawk	0	1	**0.5**
Black-shouldered Kite	1	0	**0.5**
Shining Bronze-Cuckoo	0	1	**0.5**
Tree Martin	1	0	**0.5**
Yellow Thornbill	0	1	**0.5**
Silvereye	0	1	**0.5**
Brown-headed Honeyeater	0	1	**0.5**
Yellow-faced Honeyeater	0	1	**0.5**
White-winged Chough	0	1	**0.5**

Appendix VII. Woodland birds recorded breeding at Mulligans Flat Nature Reserve, 1986-1989 and 1995-2000.

Painted Button-quail	Striated Thornbill
Brown Goshawk	Buff-rumped Thornbill
Sulphur-crested Cockatoo	Yellow-rumped Thornbill
Galah	Speckled Warbler
Superb Parrot	Superb Fairy-wren
Crimson Rosella	Dusky Woodswallow
Eastern Rosella	Varied Sittella
Laughing Kookaburra	Brown Treecreeper
Sacred Kingfisher	White-throated Treecreeper
Pallid Cuckoo	Mistletoebird
Horsfield's Bronze-Cuckoo	Spotted Pardalote
Grey Fantail	Brown-headed Honeyeater
Willie Wagtail	Regent Honeyeater
Leaden Flycatcher	White-plumed Honeyeater
Restless Flycatcher	Noisy Miner
Jacky Winter	Noisy Friarbird
Scarlet Robin	Little Friarbird
Hooded Robin	Diamond Firetail
Rufous Whistler	Olive-backed Oriole
Grey Shrike-thrush	White-winged Chough
Australian Magpie-lark	Pied Currawong
Crested Shrike-tit	Grey Currawong
Black-faced Cuckoo-shrike	Grey Butcherbird
White-winged Triller	Australian Magpie
White-throated Gerygone	Australian Raven
Western Gerygone	Striated Pardalote
Weebill	Common Starling